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PATRON: HER MAJESTY THE QUEEN

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October 17th, 1959

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The Use of Succinylcholine Chloride as a Casting Agent in the Horse Prior to the Induction of General Anaesthesia

BY

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Introduction

In recent years a number of reports have appeared on the use of the short-acting muscle-paralysing agent succinylcholine chloride, administered by intravenous injection, as a method of casting horses. The drug exerts its paralytic action by provoking a persistent depolarisation of the motor end-plates of skeletal muscle. This causes a brief initial contraction, followed by paralysis of the muscle fibres. The drug is rapidly broken down by the plasma cholinesterase into succinic acid and choline, 2 normal tissue metabolites. In the horse the plasma cholinesterase level is high (Roepke, 1936; Glick, 1937), and consequently the paralysing effect of the drug is transient in this species lasting for only 3 or 4 minutes when administered in appropriate doses. It is this transient action of the drug which makes its use as a casting agent in the horse a practical proposition, for while the period of paralysis is sufficiently long to allow the application of suitable restraining tackle, the apnoea which usually accompanies the paralysis is not of sufficient duration to endanger the horse's life. This is in marked contrast to the bovine species in which the effective dose of the drug is only about 1/10th that in the horse, and in which there is only a narrow margin between the relaxant dose and that which may cause fatal respiratory paralysis (Stowe, 1955).

In America, Belling and Booth (1955) reported on the action of the drug in 15 horses and expressed the opinion that the dangers of this method of casting are probably less than with the usual ones. Moreover, Larsen (1958) after an experience of some 500 cases expresses the opinion that the muscle relaxant is less terrifying than the restraining methods generally used.

Stowe (1955) recorded trials with rising doses of from 0.08 mg. per kg. to 1.0 mg. per kg. No deaths occurred until a dosage in the range of 0.5 mg. to 1.0 mg. per kg. was used. He concluded that the drug, used in the appropriate doses, offered a safe and practical means of casting horses. Hansson (1957) reported on over 1,000 castings by this method. The drug was administered intravenously in a dose of 0.17 mg. per kg. for Thoroughbreds and other saddle horses and 0.13 mg. per kg. in draught horses. He had one fatality in an animal suffering from volvulus. Larsen (1958) reports that in Australia the drug has come into general use as a means of casting and restraint for castration and other minor surgical interferences. Although this author had no deaths in his cases, occasional deaths were reported to him by colleagues, 2 of these being due to rupture of the abdominal aorta.

The general pattern of the drug's action reported by all these authors is strikingly constant, *i.e.*, after a period of some 36 to 60 seconds the animal quietly sinks to the ground and a period of apnoea which persists for 1 to 2 minutes develops but without significant cyanosis. The animal lies quietly relaxed for a further 2 or 3 minutes after which it rises to its feet without apparent disturbance. No records of any alarming effects associated with the heart or circulatory system, other than the rare deaths previously quoted, are to hand.

Clearly, a procedure which provokes complete paralysis of the skeletal musculature and in most cases a period of apnoea, in a fully-conscious horse, is open to criticism on humane grounds. Evidence by human volunteers that the muscular fasciculations which precede paralysis are painful would appear to add further evidence for criticism on this score. The

possibilty that painful interferences will be performed on animals unable to respond is ever present. These points have been voiced in the correspondence columns of this journal (Keen, 1958; Croft, 1958; Hare, 1958; & Croft, 1959). The present writers shared their misgivings. However, with the increasing number of favourable and even enthusiastic reports on the drug as a medium of casting, it was thought that it should be examined in a number of clinical cases and a careful assessment made of it, particularly in regard to its efficiency, humaneness and safety, in comparison with the accepted method of casting with hobbles.

This report comprises a description of these trials and a critical discussion of the results obtained.

Materials and Methods

The procedure was adopted in 20 clinical cases. All the horses were affected by some surgical condition which necessitated their being cast for the purposes of examination of treatment. They varied in weight from 290 to 1,176 lb. (132 to 534 kg.), and in age from yearlings to 7 years. With the exception of one, all were in good physical condition and relatively good health.

Large individuals were cast in a paddock while most of the immature animals and ponies were dealt with in the operating theatre, the floor of which was covered with sorbo-rubber mats. A twitch was applied and a bleb of local anaesthetic injected subcutaneously over the jugular furrow. This allowed the subsequent intravenous injection to be made with greater ease and precision, thus reducing the risk of some of the drug being inadvertently introduced in the perivenous connective tissue. The dose of succinylcholine used was that recommended by Hansson and confirmed by Larsen, *viz.* 9 mg. per 50 kg. (8 mg. per 100 lb.), as a solution containing 20 mg. per ml., the total volume varying from 1.25 to 5 ml. Injection was made rapidly occupying about 3 seconds. The twitch was removed and the animal allowed to stand unrestrained except for one man holding the halter. As the drug took effect its action was noted and recorded, with particular reference to latent period, time of collapse, respirations, and (by auscultation) heart beats. Immediately the horse fell it was quickly hobbled and restrained in right lateral recumbency. No further interference of any sort was performed until the effects of the drug had entirely disappeared. This was adjudged to be the case when the pulse rate (which under the influence of the drug was usually grossly accelerated) had fallen to 80, and the muscle paralysis had disappeared as evidenced by powerful, co-ordinated bouts of struggling. By adopting this procedure, the possibility of carrying out painful interferences while the animal was under the paralysing influence of the drug, and thus unable to react to painful stimuli, was avoided.

The Action of the Drug

Although there was some variation in the response of individuals, the general sequence of events conformed to a constant pattern.

Following the injection there was a latent period of about 20 seconds (range 10 to 35 seconds). The first visible effect was a rippling of the muscle groups behind the shoulders and in the region of the flanks which rapidly became generalised, and at this time the membrana nictitans was protruded, presumably due to contraction of the retractor oculi. Trembling movements of the limbs with slight carpal and tarsal flexion then occurred and a few staggering steps were taken. At this stage the animal usually gave the impression that it was attempting to resist the paralytic action of the drug. This period usually occupied 15 to 30 seconds. The horse then gently sank to the ground and rolled into a position of lateral recumbency with the limbs extended and quivering. Protrusion of the third eyelid had by this time ceased. It was particularly noticeable that the limbs, far from being flaccidly paralysed, appeared almost to be in a state of tetanic spasm and occasionally quite vigorous kicking movements occurred.

In most cases costal respirations had ceased by the time the animal went down, the actual instant when the onset of apnoea occurred was, however, very difficult to assess. In 3 cases apnoea did not supervene. The duration of apnoea varied from 1 to nearly 3 minutes, during which time the body was occasionally shaken by what appeared to be strong spasmodic contractions of the diaphragm. In 3 cases in which the period of apnoea was unusually long a degree of cyanosis, as observed in the gum mucous membrane, developed. In these, artificial respiration was applied by rhythmical pressure to the chest until spontaneous breathing was resumed. Following the apnoeic stage, there was a period of vigorous hyperpnoea which lasted for approximately 2 minutes. The animal then lay quietly in a relaxed state and the impression was gained that there was marked exhaustion. The return of motor power was demonstrated by occasional vigorous co-ordinated struggling.

While the action so far described gave little or no cause for concern, auscultation of the heart during the period of the drug's action revealed a state of affairs which, to say the least, was most alarming. Immediately following the fall, there was little alteration from the normal apart from a slight increase in rate. Within 15 seconds, however, gross abnormalities developed. These consisted of periods of bradycardia, with intervals of up to 6 seconds between beats, followed by rather more prolonged periods of tachycardia, during which rates of over 180 beats per minute were common. In addition, marked variations in the regularity and force of the beat occurred, and in one animal a transient systolic murmur developed. After a variable period of 3 to 4 minutes this chaotic state abated, although significant tachycardia persisted for a further 2 or 3 minutes. This tachycardia generally commenced during the period of apnoea and continued into the phase of hyperpnoea. Moreover, in cases in which apnoea was absent similar tachycardia developed. In 3 cases there was no significant tachycardia but in these bradycardia and gross abnormalities in the regularity and force of the beats occurred.

Despite these alarming cardiac symptoms none of the horses exhibited any untoward after-effects. Those which were not subsequently anaesthetised

rose quietly to their feet within a minute or two after removal of the hobbles and their subsequent behaviour was normal. Similarly in those in which general anaesthesia was subsequently induced, induction was smooth as was the recovery period. In addition, it was noted that the succinylcholine appeared to have a marked potentiating effect in the majority of cases and in these considerably more than the standard dose of anaesthetic was required to induce the necessary depth. This aspect is described more fully later.

In 3 cases the standard dose of succinylcholine failed to provoke paralysis and injection was followed merely by slight muscle tremors and protrusion of a third eyelid. There was some uneasiness for a minute or so after which the signs ceased.

injection of 8 gr. Apnoea, this time of shorter duration, however, again occurred. Six minutes later, a third injection of 7 gr. was required to maintain anaesthesia and operation (trephining of the frontal sinus) was quickly concluded. The horse rapidly recovered from the anaesthetic and was able to stand 40 minutes after induction of anaesthesia. A similar, but less pronounced, pattern was followed in the other 3 cases which received thiopentone sodium, frequent maintenance doses being necessary during operation.

At this point it was decided to dispense with thiopentone sodium in favour of chloral hydrate as the anaesthetic agent. Again, the dose of chloral hydrate required to induce a standard depth of anaesthesia was considerably reduced in the majority of cases

TABLE I
SUCCINYLCHOLINE CHLORIDE BY INTRAVENOUS INJECTION IN THE HORSE IN A DOSAGE OF 9 MG. PER KG. BODYWEIGHT

Case number	Age and sex		Weight, kg.	Time: injection to onset of tremors, secs.	Time: injection to fall, secs.	Duration of apnoea, mins.	Highest pulse rate during action	Time pulse returned to 80 mins.
1	Yearling thoroughbred	F.	382	15	35	2	—	—
2	Yearling pony	F.	180	10	12	1	—	—
3	2-year-old pony	M.	215					
	A.			20	30	1½	172 M.	7½
	B. ... ... (35 days later)			20	30	1¾	168	5½
4	Yearling shire	M.	458	20	—	—	—	—
5	3-year-old trotter	M.	445	30	90	1½	—	5
6	3-year-old thoroughbred	G.M.	413	25	75	1¾	188	8½
7	4-year-old thoroughbred	G.M.	445	25	40	2¾	160	10
8	6-year-old pony	G.M.	257	15	35	1	60	—
9	4-year-old pony	F.	257	15	60	None	—	—
10	5-year-old hunter	G.M.	534	30	45	2¾	100	5
11	5-year-old cob	G.M.	335	35	45	1¼	160	8
12	2-year-old hackney	M.	349	15	30	2	160	6
13	3-year-old pony	M.	264	15	30	2¾	192	8
14	5-year-old pony (heavily pregnant)	F.	287	20	45	None	150	8
15	7-year-old hackney	F.	409	20	35	1½	180	6
16	4-year-old pony (heavily pregnant)	F.	253	16	30	None	184	7
17	3-year-old pony	G.M.	300	20	50	1	68	—
18	Yearling thoroughbred	M.	283	30	—	—	—	—
19	4-year-old pony	G.M.	395	30	40	—	80	—
20	Yearling pony	M.	232	25	—	—	—	—

G.M. = Gelded male.

Induction of General Anaesthesia after Casting with Succinylcholine

In 18 cases general anaesthesia was induced after the administration of succinylcholine. In 4 thiopentone sodium was used and in the remaining 14 chloral hydrate. Both drugs were administered by slow intravenous injection. Administration was delayed until the effects of the succinylcholine had ceased; generally about 6 minutes after the horse fell. Using thiopentone sodium, the surgical plane was reached when only a small proportion of the calculated dose had been administered. Thus in case 12B, a pony weighing 473 lb., a dose of 10 grains induced surgical anaesthesia accompanied by apnoea which persisted for 3 minutes during which artificial respiration was applied. Anaesthesia was, however, extremely transient and 2 minutes later co-ordinated movement commenced necessitating the further slow

as will be seen from Table II. The duration of anaesthesia in these cases was 20 to 30 minutes. In 2 cases (Nos. 12 and 15) in which operation was a very prolonged one, small maintenance doses of pentobarbitone sodium were given. In the majority of cases the horse rose to its feet between 1½ and 2 hours after the induction of anaesthesia. No post-operative depression attributable to the anaesthetic method was noted.

Discussion

This method of casting horses possesses certain obvious advantages. While casting with hobbles or sidelines is a safe and practicable procedure under field conditions, it does necessitate considerable assistance and unless some at least of the casting team are experienced, accidents are liable to occur. By the use of succinylcholine on the other hand,

TABLE II
SUCCINYLCHOLINE FOR THE CASTING OF HORSES. THE QUANTITY OF CHLORAL HYDRATE SUBSEQUENTLY INJECTED INTRAVENOUSLY TO INDUCE LIGHT GENERAL ANAESTHESIA

Case number	Age and sex		Weight, kg.	Quantity chloral given, g.	Anticipated dose, g.	Unit dose taken, g. per 50 kg.	Recumbency time
3B	2-year-old pony	M.	215	21·3	28	5	1 hour 30 minutes
5	3-year-old trotter (cryptorchid) ...	M.	445	40	60	4·4	2 hours 10 minutes
6	3-year-old thoroughbred	G.M.	413	53	53	6·5	1 hour 55 minutes
10	5-year-old hunter	G.M.	534	44	68	4·2	1 hour 20 minutes
11	5-year-old cob	G.M.	335	29·5	44	4·5	1 hour 50 minutes
12	2-year-old hackney	M.	349	33	46	5	Anaesthesia maintained 40 minutes. 3 hours 15 minutes
13	3-year-old pony	M.	264	30	35	5·25	1 hour 45 minutes
14	5-year-old pony (heavily pregnant)	F.	287	37	40	6·5	1 hour 50 minutes
15	7-year-old hackney	F.	409	47	52	5·9	Anaesthesia maintained pentobarb. 2 hours 45 minutes
16	4-year-old pony (heavily pregnant)	F.	253	35	35	7	1 hour 40 minutes
17	3-year-old pony	G.M.	300	20	41	3·3	1 hour 35 minutes
18	Yearling thoroughbred	M.	283	19	39	3·4	1 hour 30 minutes
19	4-year-old pony	G.M.	395	50	54	6·3	1 hour 29 minutes
20	Yearling pony	M.	232	25	31	5·4	1 hour 50 minutes

casting can be accomplished with the assistance of one man on the head and perhaps 2 others to hold the restraining rope once the hobbles have been applied. In contrast to forcible casting, the horse sinks gently to the ground, thus the danger of injury resulting from a heavy fall is eliminated. Undoubtedly the most useful application of the drug is in unbroken or vicious animals. In these, casting by ropes may be virtually impossible owing to the horse kicking violently as soon as the tackle touches its legs.

As to the humaneness of the method; while it is always unwise to draw too close analogies between species, it must be assumed, in the absence of evidence to the contrary, that the muscle fasciculations which precede paralysis are painful in the horse as is known to be the case in man. Similarly it must be assumed that the onset of generalised muscular paralysis, associated in most cases with apnoea, has a frightening effect. The degree of distress, however, is impossible to assess, for the facial expression, which might have been expected to give some indication in this respect, is an unreliable guide owing to the action of the drug on the facial and ocular muscles. Thus, whether this method is more or less inhumane than casting with hobbles is a matter of surmise.

In attempting to measure the degree of fright which casting by the hobbles method entails, the writers have noticed when applying the method to tame horses that after the initial stage of vigorous struggling which occurs, these animals once down and effectively restrained generally lie quite quietly with perhaps an occasional bout of struggling. Moreover, the pulse rate which is accelerated by the initial struggling very quickly returns to a figure little above the normal. When, however, one is dealing with untamed animals, not only is struggling at the moment of casting severe, but it usually continues until the animal is anaesthetised.

Accepting struggling as a reliable indication of fear and distress, the writers are happier when dealing with quiet, tame animals, in using the hobbles. But when dealing with untamed or vicious animals, it is their opinion that succinylcholine offers, not only a safer and more certain method, but a no more distressing one.

Perhaps the aspect of the use of succinylcholine which has given rise to the greatest concern, is the likelihood of painful interferences being performed without adequate anaesthesia, while the horse is still under the paralysing influence of the drug. While such concern may well be justified in those instances where the drug is being administered as a muscle-relaxing agent during the course of a prolonged operation and under anaesthesia the depth of which might be doubtful, such a question does not arise when the drug is being used solely as a casting agent, and its paralysing effect allowed to cease before anaesthesia is induced. There remains the possibility that operations may deliberately be performed without anaesthesia under its paralysing influence. Such operations, however, could only be minor ones of extremely short duration, because of the transient nature of the drug's action. Larsen states frankly that in Australia castrations are performed without anaesthesia using succinylcholine as a means of restraint but points out that in any case anaesthetics are seldom employed for the operation there.

It is a matter of considerable surprise that previous workers have not drawn attention to the marked abnormalities of the heart beat which develop in horses under the influence of the drug. The cause of these abnormalities requires further investigation. It is probable that the tachycardia which develops in most cases is, at least in part, a response to the release of adrenaline due to fear. As previously stated similar tachycardia occurs in horses cast by conventional methods, but in these the heart beat slows to a rate of about 80 per minute within a minute or so after the cessation of struggling, whereas under the action of succinylcholine, significant tachycardia persists for about 7 minutes.

Additional factors must therefore be considered. Hansson suggested that the increase in blood pressure and pulse frequency is caused by reduced ventilation, the anoxaemia producing these effects *via* the chemo-receptors of the carotid and aortic bodies. It will be noted, however, that in cases 14 and 16 in which apnoea did not occur, prolonged tachycardia with rates of 150 and 184 respectively were recorded. Another suggestion of Hansson's, *viz.* that the drug has a direct effect on the cardiac centre, offers another possible explanation. But tachycardia was by no means the only abnormality of the heart beat. Gross irregularities in the force and rate of the beat occurred in all cases in which the heart was auscultated, including those in which tachycardia did not develop. Here again, it would seem that a direct action on the cardiac centre and also, possibly, on the myocardium itself is the likeliest explanation.

Although these cardiac disturbances are alarming it seems there is little danger of heart failure in healthy animals, for in none of the fatalities reported by other workers was this the cause of death. Nevertheless, the present writers would be fearful of adopting the method in an animal whose cardiac function was in any way suspect.

Those deaths due to rupture of the abdominal aorta reported by Larsen were probably the result of the considerable increase in blood pressure which the drug induces (Hansson, 1958). Larsen suggests that lesions of the aorta the outcome of parasitic infestation was a predisposing cause in these cases.

There is little danger of fatality due to overdosage. Stowe found the toxic dose to be from 3 to 6 times the therapeutic dose. Hansson and Larsen have made similar observations.

A significant feature of the drug is the variation in the response of individuals to the standard dose. Thus in the present series, the time from injection to the horse falling varied from 12 to 75 seconds, and in 3 cases (15 per cent.) the animal failed to go down.

The induction of general anaesthesia using chloral hydrate following casting by succinylcholine was found to be satisfactory. No untoward side-effects were observed and in many cases there was a significant reduction in the amount of anaesthetic required to induce surgical anaesthesia. Thiopentone sodium, however, was found to be unsatisfactory; its extremely transient action necessitating frequent supplementary injections.

Summary and Conclusions

The use of the muscle-paralysing drug succinylcholine chloride by intravenous injection as the means of casting 20 horses prior to the induction of general anaesthesia is described. The method is one which has come into extensive use, particularly in Scandinavia and Australia, it being claimed that it is a safe method and that it subjects the horse to less danger of injury than does forcible casting or the administration of narcotics in the standing position, and also that it is less terrifying to the horse than is forcible casting in the conscious state.

In this country, misgivings have been voiced as to the humaneness of the method and it was from this aspect in particular that the writers made their observations. Their opinion is that it is highly probable it does cause some distress but its extent can only be a matter of surmise. Comparing it with the forcible casting of horses with hobbles, they find themselves happier when dealing with tame, quiet horses to use the hobble method, but when dealing with unbroken or vicious animals they are of the opinion that succinylcholine offers not only a safer and more certain method, but a no more distressing one.

Attention is drawn to the marked irregularities of the action of the heart which the drug causes, a feature which has not been recorded by other observers.

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BRITISH COUNCIL COURSE ON FOOT-AND-MOUTH DISEASE

The British Council has organised a course on foot-and-mouth disease in co-operation with the Research Institute (Animal Virus Diseases), Pirbright. The course will be held at Pirbright from October 18th to 31st and the 16 members include representatives from Australia, Africa, Europe, and S.E. Asia. The syllabus covers the main aspects of current foot-and-mouth disease research, particularly the development of modified strain vaccines, tissue culture techniques applied to virus growth and titration, and biochemical studies of virus structure.

NATIONAL HEALTH ON THE FARM?

Suggestion that a "national health service" for animals should be introduced was made on Thursday, October 8th, at a Stone dairy farming brains trust, which was attended by more than 250 farmers from Staffordshire, Derbyshire, and Cheshire. Mr. Edward Moult, the television personality, was in the chair.

Mr. Peter Missen, principal of Derbyshire Farm Institute, thought that one county had started a veterinary service insurance scheme 25 years ago, but it did not work well because people paying "national health" for their cows started to queue for veterinary service.

A veterinary member of the panel said that such a scheme might be needed one day because of the economics of modern veterinary practice. Farmers, he said, did not appreciate the cost of providing a progressive, modern veterinary service. In his view there would have to be a revision of charges if the service given by the profession to farmers was to advance.

The Corrosion of Metals in Living Tissue

BY
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ALTHOUGH the use of metallic implants in surgery is said to date back to the middle ages, until fairly recently it was a process more noted for its failure than for its success. In fact, in spite of the pioneering work of Lambotte, Lane, and Sherman, it was not until the introduction of stainless steel and the chromium-cobalt-molybdenum alloys some 20 years ago that the use of metallic implants became a practical proposition. Nevertheless, apparently inexplicable failures still occur, and can only be avoided by a better understanding of the processes that go on when a piece of metal is implanted in living tissue.

Since the days of the alchemists, it has been customary to classify metals as "noble" or "base" according to the ease with which they corrode. The metallic elements can, in fact, be arranged in order of "nobility" in what is called the electrochemical series, the position of an element in this series being determined by the electrical potential that it takes up when in contact with a molar solution of its own ions, the figures being arbitrarily referred to hydrogen as zero (Table I). As it is well known that such metals as gold and platinum remain practically inert in living tissue, while iron and magnesium corrode rapidly, it might be thought that this series would be a guide in determining the suitability of a metal for surgical implantation. That it does not do so is for various reasons; for instance, the figures only apply to a metal in a solution of its own salt, and secondly, they apply only to elements, not alloys. And it is with alloys that we are mainly concerned, for although titanium and tantalum can be used satisfactorily in certain surgical procedures, most noble metals, for example gold and platinum, are too expensive and too soft to use for implantation. Certain alloys are cheaper, stronger, and under suitable conditions, equally inert.

TABLE I
ELECTROCHEMICAL SERIES

Metal	Potential (volts)
Gold	+1·5
Platinum	+1·2
Silver	+0·80
Copper	+0·34
Hydrogen	0·00
Nickel	−0·25
Iron	−0·44
Zinc	−0·76
Magnesium* ...	−2·38

* The figure for magnesium is obtained indirectly.

Steel is pre-eminent among metals for cheapness and versatility of application, but the ease with which steel rusts is proverbial. The only type of steel to resist corrosion in living tissue is what is known as stainless steel, an alloy of iron and chromium. This is not *per se* a noble metal, but owes its inertness to the fact that it is covered with a resistant skin of oxide which in the presence of oxygen is self-healing and repairs itself if damaged. And here it is necessary to emphasise that the term stainless steel covers a whole range of alloys, most of which are quite unsuitable for surgical implantation. In fact, the only stainless steels we need consider are the austenitic steels of the 18/8 and 18/8/Mo classes. These are covered by B.S.S. E.N.58A, and E.N.581, and consist respectively of alloys of 18 parts of chromium and 8 parts of nickel for the former, and 18 parts of chromium, 8 parts of nickel, and 2 to 3 parts of molybdenum for the latter, the balance in each case being made up of iron together with small proportions of other elements. It is worth noting that these alloys are non-magnetic, which distinguishes them from the low-grade martensitic steels.

The cobalt-chrome-molybdenum alloys such as vitallium are not steels, but are of even greater importance in surgery. Although more brittle and liable to fatigue (Key, 1941), they are more inert than the best stainless steels.

Anodic Back Potential

It must be realised, however, that there are many alloys used in industry that have never been used, even experimentally, in surgery, and which might prove to be more satisfactory than anything now in use. As animal experimentation with all these alloys would be prohibitively costly, Clarke and Hickman (1953), following up the work of Venable and Stuck (1938), set out to find some simple electrical constant, similar to the electrochemical potential, that could be measured for both elements and alloys, and which would serve as an indication of their inertness in living tissue. Using an electrolytic cell containing equine serum with a calomel half cell as cathode and a piece of the test metal as anode, they found that the difference between the actual work done when unit quantity of electricity passed through the cell and the work that would have been done had the cell been a simple conductor of the same resistance was a reproducible quantity characteristic for the metal being used. For "base" metals this was a negative quantity, showing that the metal was corroding freely. For "noble" metals it was a positive quantity, representing the work done in

overcoming the "corrosion resistance" of the metal. This value, known as the anodic back potential or ABE, was found for some 80 metals, and ranges from +3,500mV for titanium to −1,550mV for magnesium. It is independent of current density over a wide range. The figures for a number of metals are shown in Table II. In order to prove that this ABE was indeed a measure of inertness, short rods made from a number of these metals were inserted into the long bones of dogs (Hickman, Clarke & Jennings, 1958). After intervals ranging from 3 months to a year, the dogs were destroyed and the tissue surrounding the implant examined. It was found that metals with an ABE of over +300 were inert, while those below this value corroded readily (Table II). 18/8 steel, at + 300, caused some tissue reaction, and is probably too reactive to be safe.

TABLE II
ANODIC BACK POTENTIALS

Metal	Anodic Back E.M.F. (mV.)	Corrosion resistance (*in vivo*)
Tantalum ...	+1,650	Very good
Platinum ...	+1,450	—
Gold	+1,000	—
Cr-Ni-Mo Alloy	+ 800	Good
Cr-Co-Ni Alloy	+ 750	"
Vitallium ...	+ 650	"
18/8 Mo Steel...	+ 480	"
18/8 Steel ...	+ 300	Doubtful
Nickel	+ 200	—
Silver	+ 110	Poor
Copper ...	− 30	—
Brass	− 110	—
Mild steel ...	− 480	Nil

It might be thought that, with the discovery of this method whereby the inertness of a metal can be assessed, the problem of corrosion *in vivo* had been solved; but this is far from the case. The whole question of metallic corrosion is an extremely complicated one, and for a complete account of it such works as those of Evans (1946) or Uhlig (1948) should be consulted. The most we can do here is to consider the salient points of the problem in so far as it applies to surgical implants.

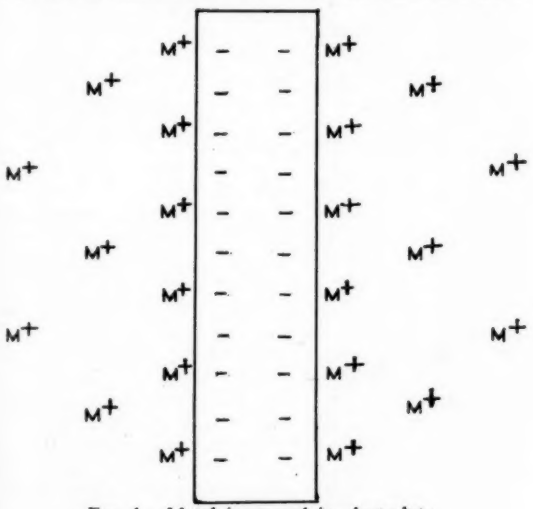

FIG. 1.—Metal immersed in electrolyte.

Mechanism of Corrosion

Corrosion may be defined as any process by which a metal passes from the elementary to the combined state. Consider the simplest case of all (Fig. 1)—a plate of homogeneous metal totally immersed in a homogeneous electrolyte. A number of positively charged ions of the metal will migrate from the plate to the liquid, leaving the former negatively charged. This process will go on until the potential difference between the plate and the liquid becomes great enough to prevent the passage of further ions into solution. A state of equilibrium will then exist. In the case of a base metal the number of ions going into solution, and hence the charge on the plate, will be considerable, but in the case of a noble metal both will be relatively small. This state of affairs represents an ideal condition when little corrosion will take place.

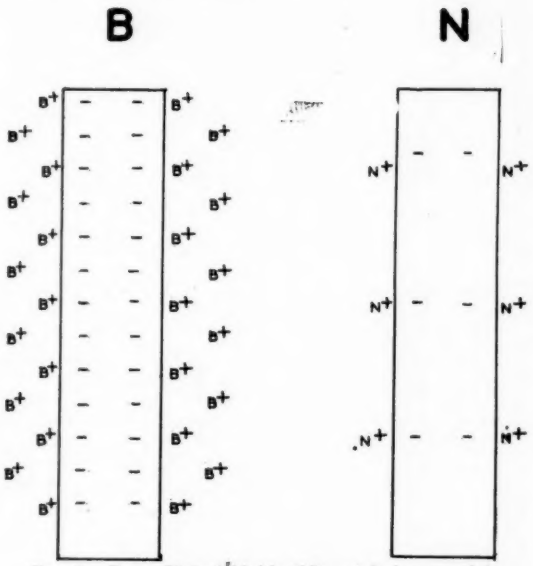

FIG. 2.—Base (B) and Noble (N) metals immersed in electrolyte.

Now consider what happens when plates of two metals, one base (B) and one noble (N), are placed in the same electrolyte (Fig. 2). As before, the base metal will lose numerous ions, and take up a considerable negative charge. The noble metal will lose but few ions, thus acquiring an insignificant negative charge. If the two plates are now joined by a metallic conductor there will be a flow of electrons along it from the base to the noble metal (Fig. 3). This will reduce the charge on the base metal and more of its ions will pass into solution, leaving more electrons on the plate. These in turn will flow along the conductor to the noble metal, where they are discharged at its surface with the electrolyte. The mechanism by which this discharge takes place varies with the metal, the electrolyte, and various other factors, and need not concern us here, as it is not the noble metal

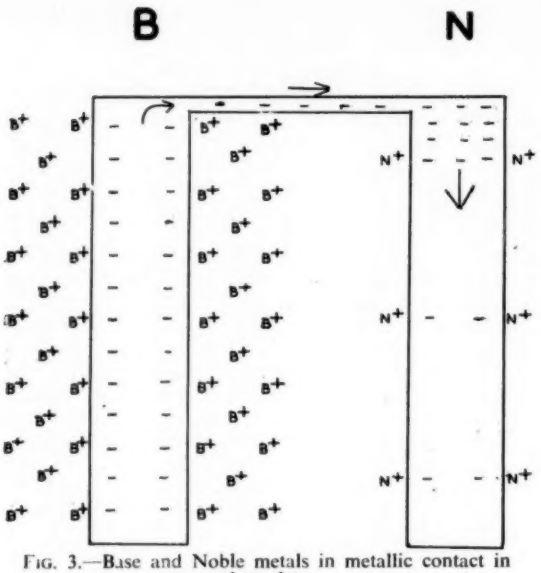

FIG. 3.—Base and Noble metals in metallic contact in electrolyte.

that corrodes. The process thus becomes a continuous one, the base metal passing steadily into solution. And this state of affairs is found whenever we have two dissimilar metals in an electrolyte in metallic contact with one another. No matter how small the piece of one metal touching the other, currents known as corrosion currents will be set up, and corrosion will take place.

Corrosion of Implants

Let us now consider how this condition of two dissimilar metals in contact applies to surgical implants. The first and most obvious case is the use of screws of one metal to fasten plates of another. This may arise from (i) ignorance—due to the surgeon not realising the danger of such a practice; (ii) carelessness, due to implants of various metals being stored indiscriminately in the same container (Key, 1946, 1950); (iii) inadvertence. Screws of one type of steel have sometimes been supplied in lieu of another (Cater & Hicks, 1956).

The second case is the transfer of metallic particles from tools to implants. If a plate be fastened to a bone by two screws and used to guide the drill making holes for the remaining screws, an appreciable quantity of the metal of the drill may be transferred to the plate where the drill bears against it. Similarly, Bowden, Williamson and Laing (1955) using radioactive tools, have shown that small quantities of metal can be transferred from the blade of a screw driver to the head of a screw.

Thirdly, there is the case where, although the surgeon thinks that he is using implants of a single metal only, he is not in fact doing so. Thus consignments of the same type of steel from two different makers may have been produced by different methods of manufacture, entailing a slight change in electrochemical properties. Even with steel of the same batch different heat treatments, as well as such operations as machining and rolling, may alter the anodic potential of the original metal. Thus, if a plate and a screw made from identical steel are subjected to different processes, they become, in effect, different metals. Different degrees of hardness may also lead to different potentials (Laing, 1958).

Fourthly, local corrosion currents may arise from surface irregularities. A depression will receive less oxygen than a protuberance, making the former anodic to the latter. Hence corrosion will occur at the site of the depression, deepening the pit, and thus exaggerating the condition. This will increase the rate of corrosion still further and so on. The gap between the head of the screw and the countersunk hole of a plate forms a natural pit where corrosion may begin (Zarek, 1957). Pitting corrosion is most common with stainless steel.

Fifthly, corrosion can be caused by stress and by fatigue. When a plate is strained, even in such a simple manoeuvre as by bending it to make it coplanar with the surface of a bone, the protective oxide film may become cracked, thus enabling corrosion to begin, the crack slowly deepening into a pit. The bending also leaves internal stresses which not only lead to the cracking of the oxide film as fast as it reforms, but also gives rise to a change in the electrochemical properties of the metal, the stressed portion being anodic to the rest of the implant. If subjected to alternating stresses, changes in crystal structure will occur and will become more pronounced until the metal ultimately reaches its fatigue limit and snaps. As corrosion occurs at the point of greatest stress, it will weaken the metal there, thus still further shortening its life (Harwood, 1950).

Finally, there is one case that is beyond the surgeon's control. Not only should the metal be homogeneous, but the electrolyte also. This condition is impossible to attain in living tissue. Local variations in ionic concentration, in *p*H value (which in the healing process may vary from 5.0 to 7.6), or in the redox potential or the supply of oxygenated blood, will lead to local differences in potential and hence to corrosion currents and corrosion. As stated above, nothing can be done to control this. We must realise, however, that all the factors we have mentioned may be cumulative. If we take every precaution to ensure that the metallic implants are inert and homogeneous, it is unlikely that variations in their living environment will be sufficient to cause serious corrosion.

Cytotoxicity of Ions

There is, however, bound to be some corrosion, as even the most inert metal will corrode to a certain extent, although the amount may be infinitesimal. In the case of such "inert" metals as vitallium and stainless steel, although the surface may remain bright and untarnished, there will be a slow passage of ions into the surrounding tissue. The concentration of these ions will of course be less than when active corrosion is taking place (Bowden, Williamson & Laing, 1958). The actual effect on the tissue will depend on the magnitude of this concentration, *i.e.* on the amount of corrosion that has taken place, and on the toxicity of the ions in question. Having dealt with the first of these factors we must now consider

the second. This problem has been approached in various ways. Verne (1953) investigated the toxicity of metallic chlorides for cultures of various types of cell. He divided metals into 4 groups in increasing order of toxicity (see Table III). He found, however, that the toxicity of some metals varied for different types of cell, and also that it was not possible to draw exact parallels between *in vitro* and *in vivo* experiments. He also found that some cells can acquire a tolerance towards certain salts.

TABLE IiI
CYTOTOXICITY OF IONS

	Real toxicity (Verne)	Apparent toxicity (Menegaux and Odiette)
Inert	Na, K, Mg, Ca	Au, Pb, Al
Slightly toxic ...	Sr, Ba, Mn, Fe, Pb, Al, Be, Th	Zn, Ag, Ta, W, Sn, Ni
Moderately toxic	Ce, Ni, Co, Au, Zn	Fe
Very toxic ...	Cd, Hg	Cu, Mg

The toxicities found by Verne are of course "real" toxicities as the actual concentration of ions present was known. Several workers, on the other hand, have measured "apparent" toxicities by noting the effect of metal plates on cultures of various cells, the difference being that in this case the concentration of ions is not known, as it depends on the rate at which the metal is corroding. Menegaux and Odiette carried out a series of experiments in which chick embryo fibroblasts and osteoblasts were placed in contact with discs of various metals. Some of their results are shown in Table III. Using similar techniques Campbell, Meirowsky and Hyde (1941) showed that gold, silver, ticonium, vitallium, and stainless steel were non-toxic, while copper and vanadium were very toxic. Trowell (1954) found that tantalum was quite inert.

It is interesting to compare these results with those of Verne (Table III). In particular magnesium, which Verne found to be non-toxic, was found by Menegaux and Odiette to be the most toxic metal of all. This is due to the fact that it dissolves readily in body fluids, with evolution of hydrogen and production of an alkaline reaction. Attempts to use magnesium in surgery have produced violent tissue reaction (Venable & Stuck, 1947) which is what one would expect from its low ABE of −1,550mV. Similarly the "apparent" toxicity of iron is greater than its "real" toxicity owing to the ease with which it corrodes. On the other hand, in the case of gold, which does not corrode, the real toxicity is greater than the apparent. These facts suggest that it is the rate of corrosion of the metal that is the primary factor, not the toxicity of its ions. The latter may, in fact, play only a limited part in the resulting tissue damage. For example, alkalinity may arise from the reaction $2H_2O+O_2+4e=4OH$ which takes place at the cathodic part of a system under oxidising conditions.

Little work has been done to determine the mechanism of the cytotoxicity of metals, although Morgan, Morton, and Parker (1951) showed that the toxic effects of cobalt for fibroblasts may be negatived by the addition of histidine.

Tissue Reaction

We must now consider how the tissues react to the implant. All metallic implants are foreign bodies, and their mere implantation will produce haemorrhage and local destruction of tissue. Subsequent reaction will depend upon the inertness of the metal, *i.e.* on the concentration of free metal ions, the toxicity of these ions, and such factors as the changes in *p*H on the surface of the implant. With an inert metal, the blood clot is replaced by granulation tissue which in turn is replaced by fibrous tissue. In a few weeks the implant will be surrounded by a fibrous sheath, in 6 months by new course fibred bone, and in about a year by normal lamellar bone. Any small areas of necrotic bone will be either resorbed or encapsulated in the compact bone. Finally, a periosteal membrane will surround the implant.

In the case of a reactive metal, there will be gross bone destruction, the implant becoming surrounded by necrotic debris. There will be a diffusion of metal into the surrounding tissues, and the implant will become encapsulated with an irregular sheath of fibrous tissue containing areas of necrotic bone. This layer of soft tissue may result in the implant becoming loose.

In the case of a very reactive metal, the fibrous tissue reaction will be accompanied by a cellular infiltration of foreign body giant cells and macrophages. This reaction should not be confused with sepsis (Hicks, 1957), which would be characterised by the presence of polymorphonuclear leucocytes and plasma cells. There may be local pain and swelling followed by a breakdown of the wound, which will not heal until the implant is removed.

Carcinogenicity

The possible carcinogenetic effect of metallic implants must not be overlooked. Fortunately, very few cases have been reported and these have occurred 30 years or more after implantation (Siddens & MacArthur, 1952; Penn & Epstein, 1953; McDougall, 1956). To date no cases of neoplasia following the use of 18/8/Mo steels or the chromium-cobalt alloys have been reported. It is well known, however, that carcinogenicity is a long-term effect and we must remember that these materials have only been used in any quantity during the last 20 years.

Experimentally sarcomas have been produced in rats by the implantation of nickel (Hueper, 1952), cobalt (Heath, 1956), gold, silver, and platinum (Northdurft, 1955), and tantalum, vitallium, and stainless steel foil (Oppenheimer *et al.*, 1956), and in rabbits, following the implantation of chromium, cobalt, and arsenic (Schinz & Uehlinger, 1942). Sarcomas have also been induced in the rat by the injection of an iron-dextran complex (Richmond, 1959).

Conclusions

A metal for surgical implantation should be one that has been proved to be inert. It should have an ABE of over +300mV and suitable mechanical properties. It should be obtained from a manufacturer of repute, who should be asked to furnish an exact analysis of its composition. It should have been tested for flaws, and, in the case of stainless

steel, should have been submitted to suitable electrochemical treatment to remove any debris deposited during manufacture and treated in nitric acid in order to provide a reliable protective layer.

Under no circumstances whatsoever should two different metals, even if each of them is inert by itself, be employed together in the same procedure.

Implants should be stored in the plastic containers in which they are supplied. Dissimilar metals, and metals from different manufacturers, must be kept separately, clearly labelled. The use of racks should be avoided. Old implants of doubtful provenance should be rejected.

For sterilisation each implant should be protected by being wrapped in gauze. During the course of the operation the implant should be handled with the greatest care in order to avoid damaging the oxide layer. Screw-holes must not be used as guides for drills and spanners and screwdrivers must not be allowed to slip. The transfer of metal may be avoided by using tools made of the same metal as the implant.

The body has considerable powers of adaptability towards foreign bodies, but this is no reason for not paying attention to all the metallurgical points involved. Corrosion is a complex reaction and the factors leading to it may be cumulative. One precaution omitted may make the difference between success and failure.

Acknowledgment.—The authors wish to thank Dr. U. R. Evans, F.R.S., for his most helpful criticisms.

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1938 LONDON GRADUATES' 21st BIRTHDAY REUNION

On the evening of October 9th, at the Farmers' Club, London, an informal gathering of veterinary surgeons who qualified from London in 1938 celebrated their 21st year in the profession.

The following were present: Messrs. G. S. Allen, D. F. V. Balls, R. A. Green, D. K. Hunt, R. Neal-Morris, R. P. Ovington, S. E. Piercy, C. W. M. Walker, R. O. W. Walpole, A. N. Worden, and Mesdames Myra Clarke (*née* Bingham), Ruth Eden (*née* Lawton), and Joan O. Joshua.

Many of these had not met since leaving the Royal Veterinary College in July, 1938. Mutual recognition was a source of much amusement and only one "clanger" resulted when one member (who shall be nameless) entered a room already fairly well populated and being apparently decidedly embarrassed at the feats of memory demanded of him advanced briskly on one of the three women present and exclaimed, "My God, how dreadful!" We had expected better of one whose career has taken him to adorn one of our greater seats of learning, a place which usually imparts poise and polish to its residents!

An extremely pleasant evening ensued, much enlivened by the type of reminiscence to be expected on such an occasion, various choice *bons mots* of our revered teachers being recalled and enjoyed once again. On the more serious side it was interesting to note the very strongly held opinion of all present that our generation of students had been exceptionally lucky in its teachers. Various august veterinary ears should have been burning that night.

A unanimous wish was expressed that a similar occasion should be arranged a few years hence and it was agreed that the "Silver Jubilee" year of 1963 would be eminently suitable.

Letters had been received from many other 1938's unable to be present, and these were read and handed round. We hope many of those who could not be with us will be able to join the reunion we hope to arrange in 4 years' time.

From a correspondent

The Duration of the Immunity in Ewes following Vaccination against Ovine Enzootic Abortion Virus

BY

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SUMMARY.—The immunity to enzootic abortion virus following vaccination with oil adjuvant vaccines was tested at intervals. Challenge of vaccinated and control ewes during pregnancy 18 months and 30 months after vaccination by inoculation of live virus showed a highly significant degree of immunity in the vaccinated animals on both occasions. Complement fixing antibody was present in sera from vaccinated animals at the 24th month after vaccination but had disappeared at the 36th month. Virus neutralising antibody was present at the 36th month but absent at the 48th month.

Introduction

An experiment to measure the duration of immunity in ewes following the injection of oil adjuvant vaccines against ovine enzootic abortion virus was started in the autumn of 1954. A preliminary report of this experiment was given in 1956 (McEwen & Foggie, 1956). The present communication records the findings up to the autumn of 1958.

Methods

The animals used in the experiment were Blackfaced ewes on the Hill Farming Research Farm at Lephinmore, Argyllshire. There was no history of enzootic abortion on this farm and the complement fixation test on a large random sample of sera from the ewes gave consistently negative titres. In September, 1954, the flock was divided into 3 groups each containing representatives of all ages of ewes on the farm. One group was vaccinated with a single subcutaneous injection of 1 ml. of a vaccine prepared from infected yolk sacs from chick embryos and a second group with a single injection of 1 ml. of a vaccine prepared from infected ovine foetal membranes. The remaining ewes formed an unvaccinated control group. Each year immunity tests were carried out on the cast ewes as they were removed from the flock.

Immunity in the cast ewes was challenged by subcutaneous inoculation of live virus during pregnancy, and complement fixation and virus neutralisation tests on sera taken from the cast ewes in the autumn each year. The techniques used have alrady been described (McEwen & Foggie, 1954; Foggie, 1954).

Results

Challenge of Ewes During Pregnancy by Inoculation of Virus

The ewes cast in 1955 and 1956 were purchased and brought to the Institute where they were mated and challenged by subcutaneous inoculation of a recently isolated strain of virus in the third month of pregnancy. The results of this test on the 1955 cast have already been reported. The ewes in the 1956 cast were inoculated with 1 ml. of a 10^{-5} dilution of heavily infected yolk sacs. Following this inoculation there were no early abortions caused by a febrile reaction such as occurred in the 1955 cast. The data relating to the pregnancies of the ewes in both years are summarised in Table I.

TABLE I
THE IMMUNITY OF VACCINATED EWES CHALLENGED BY THE SUBCUTANEOUS INOCULATION OF VIRUS 18 MONTHS AND 30 MONTHS AFTER VACCINATION

Year	1955			1956		
Vaccine	YS	FM	C	YS	FM	C
Total number of ewes	21	19	28	27	14	19
Number of ewes aborted and infected	1	2	17	2	2	12
Number of ewes lambed and infected	0	1	4	2	2	4
Number of ewes lambed not infected	20	16	7	22*	10	3
Percentage of ewes infected	4·8	15·8	75·0	14·8	28·6	84·2

YS = Yolk sac vaccine.
FM = Foetal membrane vaccine.
C = Unvaccinated controls.
* One ewe aborted but not infected.

Thus 30 months after vaccination there was still a highly significant difference between the infection rates in the vaccinated groups and the control group. The difference in infection rate between the ewes which had received yolk sac vaccine and those which had received foetal membrane vaccine was not significant although in both years the infection rate in foetal membrane vaccinated ewes was greater than in the yolk sac vaccinated ewes. Unfortunately, owing to lack of accommodation, it was not possible to carry out a direct challenge of immunity in the ewes cast in 1957 and 1958.

Complement Fixation Titres of Vaccinated and Control Ewes

The distribution of the complement fixation titres of the sera of the 2 vaccinated groups and the control groups in the autumns of 1955, 1956 and 1957 are shown in Table II.

Although the complement fixing titres were appreciably lower in the vaccinated groups in 1956 than in the vaccinated groups in the previous year there was still a highly significant difference between the titres of the sera from the vaccinated ewes and those of the sera from the control ewes. By autumn

TABLE II
SUMMARY OF THE DISTRIBUTION OF THE TITRES TO THE COMPLEMENT FIXATION TEST OF EWES BLED 1, 2 and 3 YEARS AFTER VACCINATION

Year	Vaccine	Number of sera in group	Percentage of sera with titres of :—			
			0–1 : 5	1 : 10–1 : 20	1 : 40–1 : 80	1 : 160 or higher
1955	YS	28	7·1	10·7	53·6	28·6
	FM	21	4·8	0	71·4	23·8
	C	31	100	0	0	0
1956	YS	29	27·6	34·4	31·1	6·9
	FM	16	18·8	18·8	43·7	18·7
	C	21	90·5	9·5	0	0
1957	YS	16	75·0	18·8	6·2	0
	FM	13	92·3	7·7	0	0
	C	18	100	0	0	0

YS = Yolk sac vaccine. FM = Foetal membrane vaccine. C = Unvaccinated controls.

1957, however, only a few of the sera from vaccinated animals still fixed complement and the difference between the vaccinated groups and the control group was no longer significant.

The Virus Neutralisation Test on Pooled Sera from Vaccinated and Control Ewes

The ability of pooled sera to neutralise virus as determined by intranasal inoculation of mice with virus-serum mixtures is shown in Table III.

In the years 1955, 1956 and 1957 there was a highly significant difference beween the mean pneumonia score of the vaccinated ewe sera and the control ewe sera, and there was no apparent diminution of the protection over this period. The scores for 1958, however, show no significant difference between the vaccinated sera pools and the control serum pool indicating that the sera from vaccinated ewes was no longer able to neutralise virus.

TABLE III
SERUM NEUTRALISATION TESTS SHOWING MEAN PNEUMONIA SCORES FOR GROUPS OF MICE INOCULATED INTRANASALLY WITH SERUM VIRUS MIXTURES 1, 2, 3 AND 4 YEARS AFTER VACCINATION. COMPLETE CONSOLIDATION OF BOTH LUNGS RECEIVED THE MAXIMUM SCORE OF 8

Year of test	Mean pneumonia scores		
	Yolk sac vaccine serum pool	Foetal membrane vaccine serum pool	Control serum pool
1955	0·41 (s=28) (n=20)	1·0 (s=21) (n=20)	5·2 (s=31) (n=20)
1956	2·5 (s=29) (n=27)	1·0 (s=16) (n=8)	7·7 (s=21) (n=27)
1957	0·7 (s=16) (n=30)	1·6 (s=13) (n=30)	5·4 (s=18) (n=30)
1958	3·5 (s=24) (n=23)	3·0 (s=14) (n=21)	3·2 (s=21) (n=23)

s=Number of sera in pool. n=Number of mice in group.

Discussion and Conclusions

Direct challenge of the immunity of ewes during pregnancy showed that a significant degree of protection was present 30 months after vaccination. If it is assumed that the virus neutralising antibody detectable by intranasal inoculation of mice with virus-serum mixtures is the same as the antibody which prevents the establishment of infection in sheep, this period may be extended to the 36th month. Virus neutralising antibody was, however, no longer detectable by the 48th month after vaccination. The immunity therefore fades in the 4th year after vaccination but whether before or after the 4th post-vaccinal lambing (about 42 months after autumn vaccination) has not been determined. As infection in the field is disseminated at lambing time and does not manifest itself clinically until the following year a single vaccination of ewes in the autumn of the second (gimmer) year of life may be expected to prevent abortions or infected lambings for at least 3 and possibly 4 lambing seasons.

The finding that the complement-fixing antibody disappeared before the virus neutralising antibody provides additional evidence that they are separate entities. In earlier experiments (McEwen & Foggie, 1954) it was found that after vaccination complement-fixing antibody was at its maximum titre before the virus neutralising antibody appeared.

None of the tests showed any significant difference in immune status between the ewes which had received yolk sac vaccine and those which had received foetal membrane vaccine.

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GUARD DOG TRAINING COURSES

It is reported that a number of servicemen are being given the chance of learning, before they leave the Army, how to handle guard dogs. Courses have been arranged at the Royal Army Veterinary Corps centre at Melton Mowbray, Leicestershire.

The courses are for selected men who want to be security guards after leaving the Army.

Members of the Royal Military Police, who have been given details of the scheme, have been told: "Skill in the handling of guard dogs is often an essential requirement for such jobs."

Deliberate Asphyxiation of Cattle in a Primitive Area of Uganda

BY

R. N. GOURLAY, W. R. NUNN, and T. J. COYLE

Animal Health Research Centre, Entebbe, Uganda

SUMMARY.—An investigation into the aetiology of cattle deaths at a quarantine camp in north-east Uganda is described. It was shown that a significant proportion of the deaths was due to deliberate asphyxiation.

The post-mortem *lesions of the asphyxiated cattle are given and the methods employed and motives for the killings are discussed.*

Introduction

KARAMOJA District is on the north-eastern border of the Uganda Protectorate. It is bounded on the north by the Sudan and on the east by Kenya. It is the most primitive and backward part of the Protectorate and administratively is a closed area. The main export from the District is live cattle for slaughter in the towns of Kampala and Jinja. The cattle, which are shorthorn Zebu in type of approximately 700 lb. weight, are purchased at markets throughout the District by the African Local Government and are walked to the Iriri quarantine camp which is situated on the south-eastern boundary of the District, between Karamoja and Teso.

The district is inhabited by 3 main tribes, all of which are in the Central Nilo-Hamitic group, and of these the Karamojong is the largest (Gulliver & Gulliver, 1953). The Karamojong are a war-like people, almost entirely pastoral in habit, and many of them own large herds of cattle. During the dry season the men of the tribe migrate long distances with their herds in search of grazing. Though the diet of the tribe is mainly blood, milk, meat, and grain, during the dry season migrations the men subsist entirely on blood and milk. The Karamojong have a good knowledge of the basic structures of the bovine neck and obtain the blood by placing a tourniquet at the base of the neck and shooting an arrow with a guard into the jugular vein; the arrow is then withdrawn and the blood is collected in a bowl.

The Iriri quarantine camp is an unfenced area of sixty square miles, where the cattle are held for a minimum of 2 weeks before being sent to other parts of Uganda. During this period the animals are vaccinated against rinderpest and anthrax. The cattle, when they leave the quarantine, are walked to the nearest station at Soroti, about 60 miles away in Teso, from whence they are railed to Kampala and Jinja.

During the 5 years from 1952 to 1956 inclusive an average of 12,000 head of cattle passed through the quarantine annually. The annual death rate during that time averaged 4.7 per cent.,* of which only a proportion could be accounted for by diseases, accidents, and killing by wild game. The deaths were first reported by Taylor (1951) who stated that preliminary investigations had shown that there were a number of causes which accounted for a small proportion of the deaths, but there also appeared to be a major disease factor present. This disease factor was later described by Taylor (1952) as having the following lesions on *post-mortem* examination: "congestion of nasal mucosa, petechiation of trachea, congestion of lungs, epicardial petechiae, slight pericarditis, inflammation of small intestines, congestion of venous plexus over cerebrum, sero-gelatinous infiltration in the inter-muscular fascia, and deep in the jugular grooves with occasional blood clots in their substance." During the next 4 years a number of investigations were carried out by officers of the Veterinary Department in an attempt to elicit the cause of the unknown deaths. As a result the following conditions and diseases were eliminated; reaction due to Kenya attenuated goat rinderpest vaccine and East Coast fever (Wells, 1952), diseases due to common aerobic and anaerobic bacteria (Lucas, McAnulty & Livsey, 1954), poisoning due to arsenic, prussic acid, and water contamination (Bredon & Marshall, 1954), acute hypomagnesaemia (Bredon & Marshall, 1957), while transmission experiments to healthy sheep and cattle and experimental animals of the causal agent were unsuccessful (Taylor, 1952; Bredon & Marshall, 1954). The idea that deliberate killings were occurring had been suggested more than once but had been discounted on each occasion, probably because deaths continued while investigators were present in the quarantine and also as no gross external injuries were evident.

As a further result of these investigations it became clear that the great majority of the inexplicable deaths occurred at night and were first reported when the cattle were turned out of the enclosures in the morning. Therefore, in March, 1957, an investigation was undertaken in which it was decided to watch a representative number of the cattle in the quarantine by day and night in order to observe the terminal symptoms of illness, to collect specimens from the moribund animals and to compare the mortality rate with that in the unwatched herds. This would also enable the investigators finally to eliminate the possibility of foul play.

During the investigation it was shown that deliberate killing was indeed responsible for a proportion of the deaths, and the object of this paper is to report deliberate asphyxiation as a cause of sudden deaths in cattle at a quarantine camp in Uganda and to describe the lesions seen on *post-mortem* examination.

Investigation

At the beginning of the investigation there were

* The death-rate is expressed as the percentage deaths of the total number of animals passing through the quarantine per annum.

2,317 head of cattle in the quarantine. These were divided into 4 groups composed of herds selected at random. The groups were assigned as follows:—

Group 1. 452 cattle. To be watched throughout the 24 hours.

Group 2. 452 cattle. To be watched at night only from 7 p.m. to 7 a.m.

Group 3. 452 cattle. To be left unwatched but to be collected into one enclosure at night.

Group 4. The remaining cattle, which varied in number from 961 at the beginning of the investigation to 379 at the end, to be left unwatched.

A large thorn bush enclosure or boma was built and this was divided down the middle in order to hold Groups 1 and 2 at night. A lorry was parked in the dividing wall and on it a platform was constructed, from which the two herds were watched by means of paraffin-powered flood lights and electric lights from a 110-volt generator. The generator supplied light to the further ends of the enclosure but it broke down on the fourth night and could not be repaired and was replaced by 6 paraffin vapour pressure lamps.

Observation of the cattle was undertaken by a team of 5 (later 3) European officers and 8 African veterinary assistants and stockmen. The night shifts were composed of at least one European officer, and a member of the shift walked continuously through the resting cattle in the enclosure, while the other watchers observed the animals from the top of the lorry. During the day African veterinary assistants were detailed to accompany Group 1 and the grazing areas of the herds were interchanged in order to eliminate the possibility of toxic plants and other factors in the grazing from affecting the results.

Results

The cattle were watched for 12 days and 11 nights and in that period the deaths in the various groups were as follows:—

Group 1. No deaths.

Group 2. 1 death.†

Group 3. 7 deaths.

Group 4. 8 deaths.

In addition to the deaths, one animal was "lost" from each of Groups 3 and 4. *Post-mortem* examinations were performed on 11 of the cattle that died during the investigation, putrefaction being considered too far advanced in the other 5 animals because of the delay in reporting the deaths (due to the distance of the enclosures from the camp). Two months later a confirmatory investigation was undertaken in which 2 more carcases were examined. The general picture seen on 6 of these *post-mortem* examinations was as follows:—

Externally there was no obvious evidence of violence, although 2 animals were found in an unnatural position with their necks flexed laterally. In 2 other cases there was a distinct mark round the neck, apart from the normal skin folds, which could have been caused by a rope. Severe laceration of the tongue due to biting was present on 2 occasions and large blood clots were present in the mouth. In one case the mandible was grossly displaced laterally. The eyes were very prominent and the conjunctiva congested. In a further 2 cases there was a compression of the alar cartilages, which partially occluded the external nares, together with slight bruising and congestion of the mucous membrane and, occasionally, there was a haemorrhagic exudate from the nostrils. Frequently the animal was seen to have died in the act of defaecation.

Once the skin was reflected there was marked evidence of violence, as shown by subcutaneous haematomas and bruising, varying in size from pinhead ecchymoses to large areas up to 12 inches in diameter. These most commonly occurred on the flank, over the scapulae, tuber coxae, and other bony prominences. The most conclusive lesions, however, were the multiple small and large bruises in the fascia and in the muscles on the anterior and lateral aspects of the neck; also, in a number of cases bruises were seen in the fascia anterior and dorsal to the larynx and dorsal to the trachea, pharynx, and oesophagus. Petechiae and haemorrhages were also present on the tracheal and laryngeal mucous membrane and the bronchi were usually full of froth, pink in colour, which often extended up into the trachea. In one case, a complete fracture of the fourth tracheal ring was seen. The skin and muscles of the head, neck, and shoulders showed general congestion in contrast to the rest of the carcase. When the thoracic cavity was opened the lungs were seen to be engorged with blood and ecchymoses and haemorrhages were common on the subpleura, and extending deep into the lung tissue. Small areas of emphysema were sometimes seen. The heart showed petechiae on the epicardium and in the coronary fat; the right auricle and ventricle, *vena cava*, and pulmonary vessels were distended. The blood was tarry and fluid. The abdominal mucosa and mesenteric vessels were congested, as were the other abdominal viscera.

Great care was necessary when dissecting out the tissues of the neck during the *post-mortem* examination. Each layer of fascia or muscle was examined *in situ* before being carefully removed or, in the case of muscle, freed from its attachments. This was necessary in order to eliminate macroscopic and microscopic dissection artefacts (Prinsloo & Gordon, 1951). The microscopic examination of tissues taken from the bruised region showed an infiltration of red blood corpuscles into the tissue spaces and between the muscle fibres. This, however, is not specific for *ante-mortem* bruising, as Prinsloo and Gordon indicate, but shows that the lesion is of recent origin. If the damaged area had been long standing, the tissues would have exhibited signs of inflammation, such as the infiltration of lymphocytes. Thus, though the evidence obtained from histological examination of the tissues is not specific for *ante-mortem* injury, it does reduce the time margin within which the damage could have occurred, and so confirms that the bruises, which have been demonstrated on careful *post-mortem* examination, were caused within a short time of death. Therefore the cause of death must be diag-

† The death in Group 2 occurred during the day and was diagnosed as pasteurellosis by microscopical examination.

nosed primarily from the *post-mortem* picture and not too much reliance should be placed on the histological examination of the tissues. The results of these 6 *post-mortem* examinations and the evidence afforded by the almost complete absence of deaths in the watched herds was considered as proof that a high proportion of the formerly unaccountable deaths was due to deliberate asphyxiation.

Discussion

The Iriri quarantine is about 40 miles along a poor earth road from Moroto, the administrative centre of Karamoja District. Due to the difficulty in communications and to the pressure of other work, the District Veterinary Officer was only able to pay infrequent visits. Thus, the supervision of the quarantine was left almost entirely to an African Veterinary Scout, assisted by locally recruited Karamajong herdsmen and porters.

It would appear that these deliberate killings have been occurring for a number of years, though the methods used may have varied from time to time. From the *post-mortem* examinations it is apparent that manual strangulation and strangulation by means of a rope or hide thong were the current methods employed. Occlusion of the nostrils was also used, probably in conjunction with one or other of the methods. Manual occlusion of the nostrils is a method well known to the Karamajong for raising recumbent animals and one can visualise that it is only necessary to prolong the process, with the animal suitably restrained, for asphyxiation to occur. One of us (R. N. G.) has witnessed a rather similar occurrence when an animal collapsed momentarily following the employment of this method while raising it in a crush. From our observations it would appear that, whereas the difficulty of asphyxiating alert standing animals would be considerable, with resting animals there would be little struggling and it could be accomplished by 2 or 3 men.

As expected, the *post-mortem* lesions apparently vary, depending on the method of asphyxiation and the degree of violence necessary. Manual strangulation appears to cause severe and widespread lesions in the neck region, with extensive bruising of the deeper tissues, which may vary from pin-head ecchymoses to large areas of haemorrhage, and this is obvious evidence of direct violence to the throat. The use of a rope or a hide thong appears to cause a more localised linear lesion, with possible fractures of the tracheal ring. With a rope, the pressure on the blood vessels, the carotid sinus, and vagus nerve probably plays a more important part in the actual killing than it does in manual strangulation (Smith & Fiddes, 1949). The presence of a rope mark on the neck would probably depend on the length of time the rope was left around the neck after death or the interval between strangulation and examination of the carcase.

It is of interest to note that in 1954 a Karamajong stockman was caught killing a cow, at Soroti station in Teso District, by sitting on its neck and strangling it with a stout cord. Another animal was also found dead and a *post-mortem* examination was performed on both animals by the District Veterinary Officer. The lesions described correspond closely to those recorded above. A study of the *post-mortem* reports of previous investigations at Iriri also show a number of cases with lesions resembling those of asphyxia.

The motive for these deliberate killings is not certain but it would seem that it has no political significance and that the animals are being killed solely for meat. The Karamajong regard their own cattle as capital wealth to be used for the purchase of brides, the price of which may be up to 80 head, and for ceremonial sacrifice. Therefore, although they greatly relish meat they are reluctant to slaughter their own animals. They are, however, not averse to killing and consuming animals owned by other people. Thus, the cattle held in the Iriri quarantine camp are unique for this purpose in that they are neither owned by the Karamajong nor does the tribe have to indulge in tribal warfare and raids to obtain animals for consumption. Although the stockmen are supplied with meat it apparently is not sufficient for them and, furthermore, it has become evident that meat is used for barter with the local population.

In July, 1957, following the investigation, a European Livestock Officer was appointed to supervise the quarantine. Although he remained there for only a short period, the death-rate in the cattle dropped by about 45 per cent. during the 6 months following his appointment, there being only 148 deaths in that time, compared with 342 in the previous 6 months. In 1956 there were 342 and 380 deaths respectively in the equivalent 6-monthly periods.

Acknowledgments. We wish to acknowledge the help given by Dr. F. Lothe, Medical Pathologist, in visiting the Iriri quarantine and confirming the diagnosis of asphyxiation. We would also like to acknowledge the help given by the following members of the Veterinary Department in making available their reports from previous investigations: Dr. D. L. H. Rollinson, Mr. A. Taylor, and Mr. J. R. Gibbs. We are indebted to Mr. R. M. Bredon, Mr. B. F. Marshall, and Mr. A. Odell, who assisted in the watching, to the District Veterinary Officers of Karamoja and Teso for valuable assistance in organising this investigation and to the Director of Veterinary Services and Animal Industry for permission to publish this paper.

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Clinical Note

A Simple Lighting Circuit for Surgical Measures on the Farm

F. Andrew Edgson

Reading

ONE of the main disadvantages to surgical operations on farms is the inadequacy of light. A loose-box fitted with the portable readily available materials detailed below is of great value in cases where surgery is required.

Mr. B. B. Brown, B.SC., of the National Institute for Research in Dairying, Shinfield, has supplied the following details for the construction of this equipment:--

The lighting system is run from an existing light socket in the loose-box.

Two suspending wires are fixed on the beams of the loose-box by staples at a height of 7 ft. 6 in. from floor level, a distance of 1 ft. 6 in. apart, and 2 ft. from the wall of the box. To these suspending wires is attached, by adhesive tape, a length of 7029 Twin T.R.S. no earth electric wire to form a U-shape circuit at one end of which is an ordinary lamp adaptor for connexion to existing light bracket. On each leg of the U-circuit are attached 3 G.E.C. wedge holders immediately opposite each other and at a distance of 3 ft. 6 in. between holders. When the circuit is in operation the holders will carry up to 6 × 150-watt pearl light bulbs, and is controlled by the existing light switch.

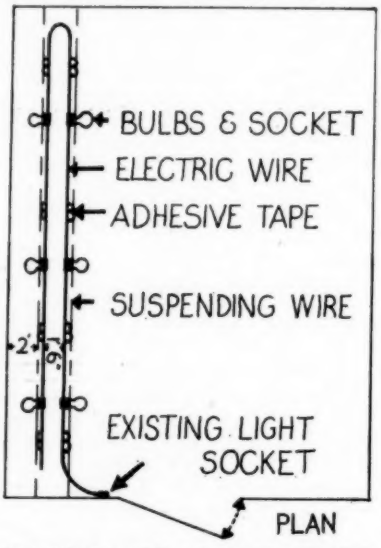
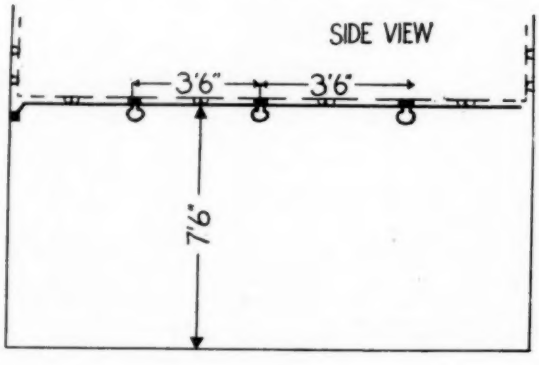


DIAGRAM OF LIGHTING SYSTEM. IN LOOSE BOX NOT TO SCALE



The whole can be easily assembled or removed, giving a temporary system which can be transported, or on removal of the bulbs the electric wire can be left *in situ* as a permanent feature needing little or no maintenance.

The present wiring system has been in operation at the National Institute for Research in Dairying for over 5 years.

THE AGRICULTURAL IMPROVEMENT COUNCIL

The Agricultural Improvement Council for England and Wales, whose members recently completed a further three-year term of office, has now been reconstituted by the Minister of Agriculture. The membership of the reconstituted Council is:—

Sir John Winnifrith, K.C.B. (Chairman), Sir Frank Engledow, C.M.G., Captain J. F. Bomford, M.C., Harold Collison, Esq., John Edgar, Esq., Professor Sir Joseph B. Hutchinson, C.M.G., K. W. T. Jones, Esq., Professor K. Mather, C.B.E., J. W. S. Mount, Esq., The Lord Netherthorpe, The Duke of Northumberland, K.G., H. J. Rathbone, Esq., O.B.E., F. Rayns, Esq., C.B.E., Sir William Slater, K.B.E., Professor P. T. Thomas, C. Thornber, Esq., Professor T. Wallace, C.B.E., and Professor E. G. White.

Mr. W. Morley Davies is Secretary to the Council.

RETIREMENT OF SIR RICHARD MANKTELOW, K.B.E., C.B.

We are advised by the Ministry of Agriculture that Sir Richard Manktelow will be retiring from the public service in the New Year.

Mr. Eric Roll will return to the Department as Deputy Secretary at the end of the year, on completion of his secondment to the International Sugar Council.

Mr. Bishop has been promoted Deputy Secretary, thus filling the post of Deputy Secretary left vacant since the retirement of Sir Edmund Harwood, K.B.E., C.B.

Sir Richard Manktelow joined the Department of Agriculture in 1914. After service in the Army during the First World War, he returned to the Department. After occupying a wide variety of posts, in which he has been associated with many of the developments in agricultural policy, he was promoted to the rank of Deputy Secretary in 1954. He received the K.B.E. in 1957. He is well known to the profession, and has been an honoured guest at many of its functions. By his retirement we are losing the day-to-day interest of an old and valued friend.

Current Literature

REVIEWS

Commonwealth Bureau of Animal Nutrition. Technical Communication No. 20.

An attempt has been made to summarise information contained in publications abstracted, or referred to by title, in *Nutrition Abstracts and Reviews* and *Animal Breeding Abstracts* up to the end of 1956. This has been supplemented by data from individual sheep breeders and correspondence with scientific workers.

Part I is a world survey of reproduction. Nine pages of introductory notes are followed by 46 pages of tables and 257 references. As might be expected, this makes dull reading but it is the perfect work of reference for the student of sheep production. Information is tabulated under the country of its origin, in alphabetical order of countries. The main headings in the tables are: per cent. ewes which were barren or aborted; number of lambs born per hundred ewes; weight of lamb at birth, and mortality of ewes and lambs.

Part II is more readable. Ten pages discuss information which has been gathered about plane of nutrition during the first winter of the sheep's life, during pregnancy, and before mating (flushing). The effects on fertility, reproduction, and lactation of protein, calcium, phosphorus, sulphur, iodine, cobalt, vitamin A, and vitamin E occupy 4 pages. For most veterinary surgeons the last 11 pages of the book will be the most useful. This section gives a clear summary of the latest knowledge concerning food requirements before and during pregnancy, and during lactation.

The standard of the Bureau's previous technical communications is well maintained by this sheep survey, and it will appeal as a work of reference to a wide section of readers.

Blood Groups. British Medical Bulletin. Volume 15. No. 2. May, 1959.

The 14 papers of this bulletin cover most branches of blood group studies with the emphasis on recent work in man. The approach is agreeably broad and many writers refer to work in animal blood groups.

Although a full account of agricultural applications is not given, the value of combining new knowledge from different species is shown in the helpful paper on human and animal blood groups.

Everyone attracted by the title will find this bulletin excellent value.

ABSTRACTS

The Cause and Nature of Grass Tetany (*translated title*). ALTEN, F., *et al.* (1958). *Zbl. Vet.* **V.** 201.

The authors, having made a critical study of published work dealing with the experimental production of grass tetany in cattle, concluded that both exogenous and endogenous factors are concerned in its causation. A typical tetanogenic factor has not so far been discovered. Cattle of weak constitution, which temporarily suffer a sudden stress produced by environmental factors (turned out to grass, change of climate or of feeding, transport journey), develop tetany earliest and most severely. High producing animals are most susceptible. In the search for tetanogenic factors a study of the mineral changes in blood serum as related to endogenous and exogenous factors was made. This showed that the seasonal and individual variations of serum levels for K, Na, Ca, and Mg under similar feeding and housing conditions were so large that little information could be obtained as to the influence of varying amounts of minerals in the diet. Even heavy doses of potassium and nitrogen fertilisers produced no recognisable effect on the blood picture. Serum mg and to a lesser extent serum phosphate in animals at pasture showed clearly defined minimal curves which seemed to be related to climate and weather. The blood picture did not prove to be a satisfactory indication of the likelihood of tetany occurring as a result of dietary changes. The theory that the application of excessive fertiliser to the ground as a cause of grass tetany received no experimental support. The occurrence of tetany seems related to a combination of endogenous factors such as constitution and disposition, acted upon by exogenous factors such as weather, feeding, transport, etc., which together upset the mineral balance. Exogenous factors alone cannot be considered the single cause, but merely the apparent exciting agent.

A. D. W.

Trial with a New Organic Phosphate as an Anthelmintic in Sheep. DOUGLAS, J. R., BAKER, N. F., & ALLEN, P. H. (1959). *Amer. J. vet. Res.* **20.** 76.

Dowco 105 (0-Methyl 0-(4 Tert. Butyl-2-Chlorophenyl) Ethylphosphophoramidothiate was administered by stomach tube. Three faecal egg counts were made after dosing and lambs were slaughtered for worm counts 6 days after dosing.

A dose rate of 200 mg. per kg. bodyweight gave an overall anthelmintic efficiency of 93 per cent. and the authors conclude that this compound warrants further investigation.

Studies on Urolithiasis. III.—The Control by Force Feeding Sodium Chloride. UDALL, R. H. (1959). *Amer. J. vet. Res.* **20.** 423.

Forty-eight lambs which fed only on a pelleted ration containing 10 per cent. sodium chloride developed no calculi in either kidneys or bladder. Companion lambs fed on a similar diet without the sodium chloride developed both bladder and urethral calculi in 30 of the 48 lambs involved. It is suggested that the increased consumption of water, associated with eating salt-diluted urinary components, might have caused calculi.

G. B. S. H.

News and Comment

VPP-FREE PIGS

Methods of establishing VPP-free pig herds were outlined to farmers last week at the Cambridge University School of Veterinary Medicine by Dr. R. F. W. Goodwin. The existing number of clean herds was very small, and as there were other desirable qualities among pigs apart from freedom from virus pneumonia it would be beneficial to introduce more of these qualities from bloodlines now outside the Association for the Advancement of VPP-free Pigs.

Discussing ways of establishing herds "clean" of the disease, Dr. Goodwin said it was useful to remember that there must be many closed herds free of the disease without the owner knowing it. These could often be detected by the application of the same standard tests as were being used on established virus pneumonia-free herds. Otherwise, existing bloodlines could be preserved by hand-rearing litters away from the sows, or by transferring litters to virus pneumonia-free foster mothers.

Both these systems, together with the original method of seeking out the non-infected sows in an infected herd, had many pitfalls. They should not be undertaken lightly or without expert supervision.

SWINE FEVER RESTRICTIONS IN KENT

From October 12th restrictions on the movement and marketing of pigs came into operation in the central and eastern parts of Kent.

Since mid-September there have been 18 outbreaks of swine fever in Kent, and investigations have disclosed that pigs which were probably in an infective stage of the disease have been exposed for sale in markets held at Ashford and Canterbury.

The movement of pigs in the infected area must be licensed by the local authority except for pigs moved straight through by rail. Pigs sent to slaughterhouses or bacon factories must be marked with a red cross. Movements of pigs to private premises (except a pig dealer's premises) are permitted under licence, but the animals must usually be detained and isolated for 28 days afterwards.

The restrictions will apply in an area comprising: the City and County Borough of Canterbury; the City of Rochester; the Boroughs of Chatham, Deal, Dover, Faversham, Folkestone, Gillingham, Hythe, Lydd, Maidstone, Margate, New Romney, Queenborough, Ramsgate, Sandwich and Tenterden; the Petty Sessional Divisions of Thanet, Wingham and Sandwich, Hythe and Romney Marsh, Cranbrook and Tenterden, Ashford, Faversham, St. Augustine, Sittingbourne and Bearsted.

MR. J. A. MATHESON

S. V. C. writes:—

It was with the deepest regret that we heard on Sunday, October 4th, that John Allan Matheson had died. He had entered Nuneaton Hospital on September 30th.

John Allan Matheson qualified in Dublin in 1937 and was for 2 years assistant to J. R. Hewer at Swindon. He always expressed appreciation of the initial training he had there. He came to Atherstone in Warwickshire in 1939 as assistant to the late Ernest Ison and after several months became partner. On the death of Mr. Ison he took Mr. Donald into partnership, and later Mr. N. Spence and Mr. Wynn Jones.

I have been privileged to be a friend of John Allan for 20 years. I soon appreciated his sterling qualities, his integrity, and uprightness. He was a kind man; he was a good man; and he has left the status of the profession at a higher level than he found it. He has been a member of, and a regular attendant at, the meetings of the Midland Counties Division of the B.V.A. and for the last 3 years has been their secretary. Seldom, if ever, has the Division been better served. He was the Worshipful Master of the Athelstan Lodge of freemasons this year.

The great respect and affection that we had for John Allan was shown at his funeral last Wednesday when St. Mary's Church at Atherstone was full. Among those present were:—

G. V. Laugier (President of the Midland Counties Veterinary Association), R. W. Betty, D. T. E. Bowen, Frank Chambers, O.B.E., J. A. R. Coates, S. V. Collard, E. R. Corrigall, D. Barry Davies, J. G. Donald, J. T. Done, H. M. M. Duff, G. M. Dunbar, D. A. Evans, E. R. Greenwood, M. Herilhy, E. J. Hodgkinson, W. Griffith Jones, J. B. Johnston, J. H. McGhee, T.D., J. Miller, J. G. Murray, W. A. Newey, A. Nisbet, W. H. Parker, W. Scott, N. Spence, A. Steele-Bodger, M. R. Steele-Bodger, W. P. Stokes, E. Wilkinson, A. White, and T. B. Yarrow.

Relations and friends mourning their great loss were joined by the full attendance of members of his Lodge of freemasons, members of his profession, and his farmer friends and clients. It was a moving service and one could sense the sorrow. We said farewell to John Allan as he was wheeled down the aisle by his brother Masons to the music of the organ playing the "Skye Boat Song." He was cremated, and his ashes taken by his brothers to the Isle of Skye and scattered on the rocks by the sea in a Scotland which he loved so well. A worthy son had come home again and left his friends to mourn for him, but fortunate were they to have known him.

John Allan Matheson leaves a widow, and our deepest sympathy goes out to her in her great loss, and to his two brothers and sister.

UNIVERSITY NEWS

Edinburgh

The undermentioned candidates have passed the Third Professional Examination (Part I) in Veterinary Pharmacology for the degree of Bachelor of Veterinary Medicine and Surgery:—

Bell, Alastair F.; Blake, George; Duncan, Walter D.; Haigh, Arthur J. B.; Hargreaves, Charles E.; Jones, Robert A.; MacIntyre, Gerald C.; Meldrum, Keith C.; Somerville, James C.; Stewart, Hugh D.; and Williamson, Alexander M.

The undermentioned candidates have passed the Final Professional Examination (Part I) in the subject of Veterinary Hygiene for the B.V.M. & S. degree:—

Abbott, John E. D.; Birch, Allen Vaughan; Campbell, Edward G.; Goad, Lewis; Harrison, Richard D.; James, William T.; Lowe, William A.; Macmillan, Elizabeth G. M.; Moar, John A. E.; Oduro,

Gottfried A.; Pratt, John H.; Reeves, Ronald J. C.; Robson, Richard P.; Schermbrucker, Christopher G.; Searles, Patricia A.; Seckington, Ian M.; Smith, Margaret E.; Somerville, John R.; Spence, Albert B.; and Thomas, Gruffyd W.

FOOT-AND-MOUTH DISEASE WARNING

Owners of livestock, particularly in coastal areas in the south of England, have been warned by the Ministry to keep an extra careful watch for suspicious symptoms in their animals and to report at once to the police if they suspect foot-and-mouth disease. Outbreaks of foot-and-mouth disease in parts of France bordering the English Channel showed a sudden rise in August. A further sharp increase occurred in September, and there is a risk of infection being introduced from the Continent by the migration of birds at this time of the year.

There have been no outbreaks of foot-and-mouth disease in the United Kingdom since early June. Up to that time there were 5 primary outbreaks in England which gave rise to 4 secondary outbreaks.

Outbreaks of foot-and-mouth disease in the areas in France bordering the English Channel have risen from 11 outbreaks in July to 88 in August and to 189 in September.

MR. PETER THRALE

Mr. Peter R. A. Thrale, O.B.E., whose death was announced last Monday, graduated in 1909 at London. He was a well-known trainer at Epsom and had twice won the Cesarewitch. The first time was in 1932 with "Nitsichin," and the second in 1951 with "Three Cheers."

He was a member of a family which has been connected with the turf for more than a century. His grandfather was a veterinary surgeon at Croydon, and Peter Thrale continued the family tradition in the same profession and then set up as a race-horse trainer.

Besides his many successes as a trainer, he was perhaps best known as a judge of yearlings. As a veterinary surgeon, his practised eye could often discern hidden promise for the future when it was invisible to the ordinary man.

Many owners without funds to pay for fashionably-bred animals had cause to be grateful for his judgment, and both at Epsom and throughout the racing world he will be sorely missed by his many friends.

THE REGISTER OF VETERINARY SURGEONS

Restoration. Under the provisions of Section 17 (3) of the Veterinary Surgeons Act, 1948, the name of the undermentioned was restored to the Register of Veterinary Surgeons on October 2nd, 1959: Collins, Frank Vernon, Australia House, Strand, London, W.C.2.

Removals. Under the provisions of Section 25 (3) of the Veterinary Surgeons Act, 1949, the names of the undermentioned were removed, at their own request, on October 2nd, 1959: Scott, John, 1, Beauchamp Road, Leamington Spa, Warwicks; Thomas, Charles James Armstrong (*Supplementary Veterinary Register*), 237, Kenton Lane, Kenton, Middlesex.

PERSONAL

Mr. J. N. Ritchie, C.B., F.R.C.V.S., B.SC., D.V.S.M., F.R.S.E., President of the Royal College of Veterinary Surgeons, was made an Honorary Member of the American Veterinary Medical Association during the annual congress of that Association.

Marriage

ROBERTSHAW—MACRITCHIE.—On October 2nd, 1959, at Glasgow University Memorial Chapel, David Robertshaw, B.V.M.S., M.R.C.V.S., eldest son of Mr. and Mrs. R. Robertshaw of Stafford, to Margaret Jean MacRitchie, younger daughter of the late Rev. and Mrs. Kenneth MacRitchie of Dunfermline.

Births

MOWAT.—On September 24th, 1959, at St. Luke's Hospital, Guildford, to Joan, wife of G. Noel Mowat, M.R.C.V.S., a son, Nicholas George, a brother for David.

PHILLIPS.—On October 6th, 1959, to Alma, wife of Edward Phillips, B.V.SC., M.R.C.V.S., of Liverpool, a daughter, Susan Brenda.

COMING EVENTS

October

21st (Wed.). Meeting of the Warwickshire Veterinary Club at the Regent Hotel, Leamington Spa, 8 p.m.

22nd (Thurs.). General Meeting of the South Eastern Veterinary Association at the Royal Star Hotel, Maidstone, 2.30 p.m.

23rd (Fri.). Annual General Meeting of the Scottish Branch at the Royal (Dick) School of Veterinary Studies, Edinburgh, 2.30 p.m.

24th (Sat.). Meeting of the B.S.A.V.A. North West Region at the Swan Hotel, Chester, 7.30 p.m.

R.A.V.C. Old Comrades' Association Annual Reunion and Dinner at The Regimental Club, Westminster Dragoons, London, S.W.1.

27th (Tues.). Meeting of the Society for the Study of Animal Breeding at the Royal Society of Medicine, 1, Wimpole Street, London, W.1, 11.30 a.m.

Meeting of the Society for the Study of Animal Breeding at the Royal Society of Medicine, 1, Wimpole Street, London, W.1, 11.30 a.m.

28th (Wed.). Meeting of the Dumfries and Galloway Division, at the Ernespie Hotel, Castle Douglas, 2.15 p.m.

General Meeting of the Sussex Veterinary Society at the Old Ship Hotel, Brighton, 2.30 p.m.

29th (Thurs.). Meeting of the R.A.V.C. Division at the Home of Rest for Horses, Boreham Wood, Herts., 11 a.m.

30th (Fri.). Meeting of the A.V.T. & R.W. Southern Region at the Royal Veterinary College, Camden Town, N.W.1, 2.30 p.m.

Meeting of the Yorkshire Division at Parkway Hotel, Bramhope, Leeds. (*N.B.* change of venue.)

Autumn General Meeting of the North of England Veterinary Medical Association in the Physics Theatre, King's College, Newcastle upon Tyne, 7 p.m.

Autumn Meeting of the Eastern Counties Veterinary Society at the George Hotel, Colchester, 11.30 a.m.

November

4th (Wed.). Fourth Annual General Meeting of the R.V.C. Association at the Royal Veterinary College, London, N.W.1, 5.30 p.m.

11th (Wed.). General Meeting of the Lancashire Veterinary Association at Liverpool, 2.30 p.m.

13th (Fri.). Annual General Meeting of the North Wales Division at the Gwydyr Hotel, Bettws-y-Coed, 2 p.m.

22nd Commemoration Ball of the Royal Veterinary College in the Great Hall, 8 p.m.

18th (Wed.). Meeting of the Scottish Metropolitan Division in the Royal (Dick) School of Veterinary Studies, Edinburgh, 2.30 p.m.

26th (Thurs.). Meeting of the B.V.A. Overseas Committee at 7, Mansfield Street, London, W.1, 11 a.m.

28th (Sat.). Meeting of the Metropolitan Region of the B.S.A.V.A. at 1, Wimpole Street, London, W.1; dinner 7 p.m. for 7.30 p.m.; paper 9 p.m.

B.V.A. COMMITTEE AND COUNCIL MEETINGS IN LONDON

Tuesday, November 3rd—at 7, Mansfield Street
5.00 p.m. Finance Sub-Committee.

Wednesday, November 4th—at 7, Mansfield Street
10.00 a.m. Parliamentary and Public Relations Committee.
11.30 a.m. Farm Livestock Committee.
2.15 p.m. Small Animals Committee.

Thursday, November 5th—at 7, Mansfield Street
10.00 a.m. Veterinary State Medicine Committee.
11.30 a.m. Home Appointments Committee.
2.30 p.m. General Purposes and Finance Committee.

Friday, November 6th—at Connaught Rooms, Great Queen Street, London, W.C.2
10.15 a.m. Council Meeting.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Anthrax

Dumfries. Laneside Farm, Troqueer (Oct. 12).
Lancs. Siddows Farm, Henthorn, Clitheroe (Oct. 12).
Norfolk. Top Farm, Little Gransham, Dereham (Oct. 12).
Northants. Doddington Crossing, Doddington, Wellingborough; West Meadow, Union Lane, Wellingborough (Oct. 12).
Renfrew. Larkfield Farm, Gourock (Oct. 12).
Yorks. Burniston Farm, Burniston, Scarborough (Oct. 6).

Fowl Pest

Aberdeen. Auchmallidie Mains, Maud (Oct. 10).
Essex. 28, Wybury Road, Daws Heath, Hadleigh (Oct. 7); 125, Rectory Road, Pitsea (Oct. 9); Stebbings Park, Stebbing, Dunmow (Oct. 10).
Glouc. Newhouse Farm, Hawling, Andoversford, Cheltenham (Oct. 6); Castle Barn Farm, Dowdeswell, Cheltenham: Horse and Groom Inn, Bourton-on-Hill, Moreton-in-Marsh (Oct. 7);; Springhill Camp, Moreton-in-Marsh (Oct. 8); Bouchers Farm, Bentham, Cheltenham (Oct. 10); Neata Farm, Greet, Winchcombe, Cheltenham (Oct. 12).
Herts. Ruboic, The Flint, Haydon, Royston (Oct. 10).
Kent. 3, Well Street, East Malling, Maidstone; Little Gables, Gt. Buckland, Cobham, Gravesend (Oct. 6); Bakerden Farm, Lamberhurst, Tunbridge Wells; Saynden Farm, Staplehurst (Oct. 7); Manor Farm, Borstal, Rochester; 1, Hare Plain, Biddenden, Ashford (Oct. 11).
Surrey. 116, Burlington Road, Thornton Heath; 11, Howberry Road, Thornton Heath (Oct. 6).
Sussex. Little Coldharbour Farm, Punnetts Town, Heathfield (Oct. 10); Durrants Farm, Rushlake Green, Heathfield (Oct. 11).
Warwicks. Railway Crossing P.F., Darlingscote Road, Shipston-on-Stour; Mount Farm, Campden Road, Shipston-on-Stour (Oct. 6); Darlingscote Hill, Shipston-on-Stour (Oct. 7).
Wilts. Marsh Farm, Jacksons Lane, Chippenham (Oct. 8).
Worcs. Tower Farm, Honeybourne, Evesham (Oct. 8).
Yorks. Kingsley Poultry Farm, Starbeck, Harrogate (Oct. 7); Hilltop Farm, Shadwell (Oct. 9); 95 and 97, Dragon Allotments, Harrogate (Oct. 12).

Swine Fever

Cambs. Priory Farm, Upwell, Wisbech (Oct. 7).
Ches. Tanyard Farm, Birch Heath Road, Tarporley (Oct. 6); Hoofield Hall, Clotton Hoofield, Tarporley (Oct. 7); Yew Tree Farm, Clotton (Oct. 12).
Devon. Ford Farm, Wilmington, Dalwood, Honiton (Oct. 8).
Dorset. Shillingstone House, Shillingstone, Blandford Forum (Oct. 8).
Essex. Balmoral, Cross Road, Thorington, Colchester (Oct. 8).
Glouc. Oxwych Farm, Yate, Bristol (Oct. 8).
Hereford. Mainstone Court, Munsley, Ledbury (Oct. 6).
Herts. 65, Garden Walk, Royston (Oct. 12).
Kent. Gusbourne Farm, Appledore, Ashford (Oct. 6); Whitehall Farm, Capel le Ferne, Folkestone (Oct. 7); Lime Kiln Farm, Smarden; The Moat, Church Lane, Shadoxhurst, Ashford (Oct. 8); Tearnden Farm, Bethersden, Ashford (Oct. 12).
Norfolk. Old Hall Farm, Trowse, Norwich (Oct. 9).
Lancs. Coggra Fold Farm, Radcliffe, Manchester (Oct. 7); Israels Farm, Over Hulton, Bolton (Oct. 9).
Salop. Ty Coch, Sychtyn, Oswestry (Oct. 12).
Suffolk. Moor Green, Staningfield, Bury St. Edmunds (Oct. 8); The Piggery, Pot Hall Road, West Row, Bury St. Edmunds (Oct. 12).
Surrey. Fairchilds Farm, Chelsham (Oct. 8).
Sussex. Slindon Stables, Slindon, Arundel (Oct. 7).
Somerset. Rectors Farm, Rectors Way, Weston-super-Mare (Oct. 7); Middle Farm, Ham, Shepton Mallet (Oct. 12).
Staffs. 156, Ashby Road, Donisthorpe, Burton-on-Trent (Oct. 8); Hollycroft, Lordsley Lane, Ashley, Market Drayton (Oct. 12).
Warwicks. The Croft, Long Itchington, Rugby (Oct. 7); Whitchurch Farm, Whitchurch, Stratford-on-Avon (Oct. 8); Napton Fields Farm, Southam, Leamington Spa (Oct. 12).
Yorks. Carr House, Lound, Haxey, Doncaster (Oct. 9); Hurdhill Farm, Northowram, Halifax (Oct. 12).

ADVERTISER'S ANNOUNCEMENT

BURROUGHS WELLCOME & Co. announce the issue of "Fomodox" brand Compound Pessaries (Veterinary). Each pessary contains streptomycin sulphate—250,000 I.U. polymyxin B sulphate—25,000 I.U. and stilboestrol 10 mg. in an effervescent disintegrating base. The stilboestrol is incorporated in the substance of the pessary using an entirely new pharmaceutical process: it is so dispersed throughout the pessary that the effective dose of this hormone is thereby reduced. "Fomodox" pessaries are packed in plastic boxes of six.

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

SCIENTIFIC

Haemonchus spp. x-irradiated Larval Vaccine in Nigerian Zebu Cattle

Sir,—Twenty-six Zebu and Zebu × Friesian calves were raised parasite-free from birth. Twelve of the calves, aged between 5 and 9 months, were dosed twice at monthly intervals with 10,000 *Haemonchus* spp. larvae which had received a 60,000 roentgens dose of X-rays. These larvae were cultured from the faeces of donor calves, infested with pure *Haemonchus* spp. at Vom, and were flown to the Glasgow University Veterinary School where they were x-irradiated. One parasite-free calf was dosed with 10,000 viable untreated larvae, from the same larval harvest as the vaccine larvae, when the first x-irradiated larval dose was administered to the 12 calves, and another parasite-free calf was similarly dosed with viable larvae when the second vaccine dose was administered. These 2 larval viability control calves developed high *Haemonchus* spp. faecal egg counts proving the infectivity of the vaccine larval harvest. The remaining 12 calves acted as parasite-free controls. One vaccinated calf was slaughtered 3 weeks after the first x-irradiated larval dosage, and another 3 weeks after the second x-irradiated larval dosage in order to ascertain the fate of x-irradiated larvae. Six weeks after the second dose of x-irradiated larvae, 5 vaccinated calves were challenged with 10,000 normal infective *Haemonchus* spp. larvae and 6 control calves were similarly challenged. When the infection was established in the 6 control calves, 7 weeks after challenge, the 5 vaccinates and the 6 controls were slaughtered. The mean mature *Haemonchus* spp. worms found at *post mortem* in the vaccinates was 728 and in the controls 2,624. In addition 300 immature 5th-stage *Haemonchus* spp. worms were found in one of the vaccinates as against none in the controls, while the mean count of 4th-stage larvae in the vaccinates was 740 as compared with 383 in the controls. The vaccination procedure thus resulted in a 60 per cent. reduction in all stages of the *Haemonchus* spp. worm burden.

The remaining 5 vaccinate calves, along with a further 6 controls, were placed on a pasture, heavily infected with pure *Haemonchus* spp. larvae in order to receive a natural challenge at the same time as the other calves received the artificial challenge of 10,000 larvae. The object of this was to compare the artificial with a natural challenge and also to assess the degree and length of immunity under natural conditions. This aspect of the experiment is continuing and will be reported at a later date, as will the full details of the entire investigation. The results show that there is every likelihood that an efficient vaccine against *Haemonchus* spp. infection in cattle can be developed using x-irradiated larvae, but further work is required to assess the dosage of X-rays necessary to produce the desirable degree of attenuation of the larvae. Consideration of our results in the light of the findings of Jarrett *et al.* (1959) in sheep, suggests that the dose used (60,000 roentgens) was excessive, and that a smaller dose may be the more suitable. Lack of numbers of parasite-free calves precluded the inclusion of additional groups to compare the relative efficiency of varying x-irradiation doses of the vaccine larvae in the present trial, but further investigations are proceeding to assess the optimum x-irradiation dosage. We are indebted to Dr. Jarrett, Mr. Sharp, and the staff of the Glasgow School for having irradiated our larvae and for their most helpful advice.

Yours faithfully,
J. G. ROSS,
J. ARMOUR,
J. HART,
R. P. LEE.

Federal Department of Veterinary Research,
Veterinary Research Laboratories,
Vom,
Nigeria.
September 21st, 1959.

Reference

JARRETT, W. F. H., JENNINGS, F. W., MCINTYRE, W. I. M., MULLIGAN, W., & SHARP, N. C. C. (1959). *Am. J. Vet. Res.* **20.** 527-31.

Revision of the Nematode Genus Setaria

Sir,—I read with interest Dr. L. Z. Saunders' letter in a recent issue of THE VETERINARY RECORD (**71,** 631-2), concerning my revision of the genus Setaria, published in the *Journal of Helminthology,* 1959 (**33,** 1-98).

Two aspects of the "Revision" have been commented upon by Dr. Saunders: (a) the taxonomy of the genus Setaria which forms the major part of the work, and (b) some remarks of mine on pathology which occupy less than two pages. Regarding the former, he has complimented me for "yeoman service" in making order out of chaos, but at the same time suspects, without giving any reasons, that I have raised a number of contentious points in parasitology, and hints that all is not well with my new classification. Dr. Saunders' suspicions do not worry me. He is clearly on unfirm ground in discussing such matters and floundered in a quagmire with "cerebrospinal nematodiriasis" (Nematodiriasis = disease due to *intestinal* parasites of the genus Nematodirus!). Regarding the section in my "Revision" on pathology, which is the main target for Dr. Saunders' comments, this is a brief account in which an opposing point of view is stated. He accuses me of "misleading statements" and "disparaging remarks" and seems incensed at my description of certain publications as "a flood of reiterative papers." One cannot help wondering at the vehe-

mence of this attack. I do not intend to deal here with the various points raised in it for it would take up too much of your valuable space and might only serve to initiate a frothy back-wash to the " reiterative flood."

Yours faithfully,
YEH LIANG-SHENG.

Department of Parasitology,
London School of Hygiene and Tropical Medicine,
London, W.C.1.
September 30th, 1959.

GENERAL

Intussusception in Chinchilla lanigera

Sir,—The subject of this communication was a male about 5 months old which had been under treatment for enteritis, with apparent recovery.

It was observed a day or two later that the faeces were hard and small, and later, absent, while the animal began to look ill. Examination showed a trace of blood at the anus, and a diagnosis of intussusception was made though none could be palpated. As the animal was not under guarantee, permission to operate was obtained.

Anaesthesia was induced by pentobarbitone sodium at 1/64th gr. per oz. bodyweight, diluted to 5 c.c. with warm glucose-saline to combat shock, with some chloramphenicol added to suppress secondaries. (Subsequent experience suggests that 2 or 3 c.c. bulk might be better.) This was injected into the flank with a very small, sharp needle, and appeared to be unnoticed.

A mid-line incision of about 1½ inches was made, taking care not to nick the caecum. That organ, and the bulk of the intestine were drawn readily from the wound, deflected to the animal's right side, and kept warm with hot wet swabs. The invaginated bowel proved to be about 3 inches of the upper rectum, and although it was by now 18 hours after the first appearance of blood there was no trouble with adhesions.

The intussusception was relieved by very gentle squeezing and traction, and although the mesentery was torn its blood vessels appeared intact. The viscera were replaced, and the body wall and skin sutured in two layers with 3/0 gut. During recovery from anaesthesia it was found necessary to maintain body temperature with hot-water bottles and infra-red rays.

Except for a few days of capricious appetite recovery was uneventful.

Yours faithfully,
HOLLAND BIRKETT.

50, Bridge Road,
Cove,
Farnborough,
Hants.
September 30th, 1959.

A Scale of Veterinary Fees

Sir,—The data collated by the S.P.V.S. should be helpful in enabling the B.V.A. in the not too far distant future to establish, maintain, and enforce adherence to, as a condition of membership, a sensible minimum fee schedule. With the steady advance of the profession to its legitimate place in modern society, the absence of such a schedule is regrettable, and a serious economic handicap.

Members who are prepared to accept a low fee for their services are lowering the status of their profession in the eyes of the public. Similarly, persons who ask for small fees are invariably well able to pay higher ones. I believe that colleagues who have had experience of free treatment schemes will agree that its chief patrons are well able to pay. Those who are in the category for whom such schemes were devised desire to pay something, if only to put a contribution in the collecting box. The inherent good sense and responsibility of the majority of veterinary surgeons can be relied upon to vary fees according to circumstances; but even so, they should have the protection of a minimum fee, below which nobody shall be allowed to go.

Yours faithfully,
J. F. D. TUTT.

" Rothiemurchus,"
Winchester.
October 10th, 1959.

Bone Pinning in a Green Monkey

Sir,—In answer to the letter of Miss Fardell, published in THE VETERINARY RECORD of October 3rd, may I give the following information:—

In July of this year a young performing monkey, of approximately 7 lb. bodyweight, was brought to me suffering from a fractured femur, upper third. Twenty-four hours after the accident had occurred the monkey was anaesthetised with intravenous nembutal, using a radial vein, ½ ml. of nembutal being sufficient to induce anaesthesia. No premedication was given.

The fracture was repaired by open reduction and intramedullary pinning. No difficulties were encountered during the operation and recovery from anaesthesia was uneventful. The monkey was returned home 24 hours after the operation. Four weeks later it was seen again and observed to be using the leg normally, X-ray photographs confirming bone healing. Two weeks later the monkey was seen again when there was still no discomfort from the pin, and the animal was performing normally. I decided to leave the pin *in situ*.

I venture to suggest that these small monkeys present no abnormal surgical risks, and I must conclude that Miss Fardell was perhaps a little unfortunate in her experience.

Yours faithfully,
W. SHIPLEY.

Southtown,
Great Yarmouth.
October 8th, 1959.

A History of the R.A.V.C.

Sir,—May I suggest that the committee of the B.V.A., which is dealing with financial aid to publish this important work, might consider inviting subscriptions not only from within the profession, but also from others, like myself, who would consider it a privilege to contribute.

The future value of such a work cannot be overestimated. While making some searches concerning horse shoes and their history, I was amazed to find so little was known.

Yours faithfully,
IVOR HUGHES,
Member of the Society, Army Historical Research.
"Honeysuckle Cottage,"
Coleshill,
Warwickshire.
August 25th, 1959.

The Clinical Specialist

Sir,—May I, as concisely as I can, describe a pattern of development of the clinical departments which, I think, would train better clinicians and clinical teachers than the one advocated by Dr. Goodwin in his article, "The Clinical Specialist," in THE VETERINARY RECORD of September 26th, 1959.

To my mind, too, the basic problem is scientific training, the development of "scepticism and objectivity" in clinical medicine. Surely a better way to do this is to carry out clinical research in the veterinary school, *i.e.* to conduct trials of drugs both new and old; to follow up "impressions" scientifically. The problems arising in the conduct of such trials will profit both the student and the teacher and maybe will encourage some to follow up their "hunches" in the field later.

Since the Veterinary Therapeutic Testing Board has run short of ideas so early after its formation, perhaps I should back up this line of thought with some ideas on suitable topics for research—not great advances in themselves but of interest to the veterinary profession, with the promise of quick results (an encouragement and advantage in the training of the veterinary clinician who will be able to see such experiments through to the end). It would also be a training ground over which the Board could overcome some of the unforeseen pitfalls encountered in such work and so develop better methods for future work, *e.g.*:—

(1) Supportive treatment versus antiserum and supportive treatment in the treatment of the distemper—hard pad complex.
(a) In a mild epidemic (*i.e.* mortality and/or nervous signs 10 per cent. or less).
(b) In a bad epidemic (*i.e.* mortality and/or nervous signs 50 per cent. or more).

(2) The value of parenteral antibiotics in the treatment of severe post-parturient metritis or mastitis in the cow compared with local treatment only—the dosage used, and economics too, if of interest.

(3) Serial milk samples from cases of mastitis caught early in the field for comparison with that induced experimentally, especially in those cases where the antibiotic used does not kill the organism concerned.

(4) The factors concerned in the epidemiology of disease, especially the influence of the weather and management—separating out those factors which matter from those that do not, *e.g.* rain and milk fever rather than summer and milk fever.

(5) The problem of the antibiotic-resistant organism, *e.g.* if enteric organisms never develop resistance to neomycin surely this is the drug of choice in calf scour—providing it is not toxic when given in adequate dosage. If resistance can arise, how can this best be prevented or circumvented—or does it not matter? As in the case of other antibiotics the promise of increased use is likely to bring about a substantial reduction of price.

This type of research requires a large number of routine cases and reasonably simple routine laboratory techniques well within the scope of all veterinary schools. More complex problems than this are now passing into the realm of the research team rather than the specialist clinician, who presumably will make his mark answering questions similar to those asked above, provide "impressions" for the research team, be better trained to spot new syndromes in the field as a result of such training, and provide field evidence in support or against the research side. To my mind this species of veterinary surgeon is the one we lack most.

Yours faithfully,
C. M. GOULD.

12, Landguard Road,
Southampton.
October 12th, 1959.

Sir,—Until recently, clinical diagnosis has been based upon observation and the employment of the senses. The ability to perceive signs of illness and to translate these into a mental picture of what goes on within the body has, hitherto, characterised the discerning and experienced clinician. As man progresses he adds to his tools.

The early veterinary practitioners were provided with their own senses, a thermometer, and a stethoscope. Most of them had been brought up in association with animals, and understanding them as living creatures knew them both in health and sickness. The modern clinician is equipped with a great variety of instruments, he receives expert advice from laboratories specialising in every branch of science, and it is not surprising if he places complete dependence upon his new resources and is apt to forget to make full use of the senses with which he is endowed.

It is unfortunate if he is led into regarding the possession of tools as evidence of craftsmanship.

Many who are expert in the manipulation of a comptometer are poor mathematicians, and the less capable one is of adding up two rows of visible figures the more one appreciates the comptometer. Nobody will deny the value of new tools and new machinery, but automation is not wholly devoid of danger; and in our own case a too slavish devotion to mechanical and laboratory aids will not ensure clinical perfection.

The more rapid our academic progress, the greater is the need to retain a sense of proportion. Even if the clinician of to-day may occasionally scorn the practitioner of yesterday, so in all probability the clinician of to-morrow may regard the product of to-day as being equally lacking in understanding. We must accept it as fact that the great majority of us are ordinary simple folk who have been here a long while. The clinical specialist is a product of the new generation.

It may be quite true that we have become unduly complacent and that a little rousing will do us good. Unfortunately, however, from the strictly academic angle, most people engage in private practice in order to live, and they do this only for as long as they satisfy their clients and convince them that they are giving value for money. While a complete diagnostic service should be our aim many of our patients cannot wait, and their preservation demands immediate action. In the rush and scurry of practice the clinician is expected to provide a diagnosis on the spot, not with the aid of laboratory findings but by means of his own power of observation aided by many years of experience. He will be expected to offer one which will stand up to subsequent events, and he will not enhance the confidence of his client if he informs him that whatever he tells him will probably be wrong since it is an accepted fact that the only truly reliable diagnosis is the one which results from *post-mortem* findings.

Any treatment we advise must be directed towards a speedy removal of conditions likely to be a cause of illness. We must do all we can to further recovery, and avoid all measures likely to hasten the end of our patient. Whatever we do must be put into effect immediately. It is even possible that while we are awaiting laboratory assistance our patient may die —or recover without our aid.

The point which it would appear desirable to emphasise is that while we must respect and welcome modern techniques and regard the clinical ability of the new generation with profound admiration, we should continue to teach our students to make proper use of their senses, remembering that even in the bad old days a great many useful diagnoses were made solely by the use of the eyes, the ears, and the nose, and by the sensitivity of human fingers.

Yours faithfully,
R. H. SMYTHE.

6, Peveril Drive,
The Park,
Nottingham.
October 12th, 1959.

Operation on a Rabbit

Sir,—I have never studied veterinary literature on the rabbit apart from general advice on feeding and management, and I feel, therefore, that the following case may be of interest to colleagues in a similar position.

The subject was a white Beveran doe about 1 year old and 8 lb. in weight.

Within 24 hours of normal time of parturition she was seen to be distressed, showed no interest in food, and the box was wet. Examination revealed a viscus about 1½ inches in diameter protruding from the vulva. It had a distinct neck, and any attempt to replace it was unsuccessful. It was thought to be bladder by its shape although mucous membrane was much more likely to prolapse.

Abdominal palpation did not suggest recent attempts at expulsion of the several foetuses which were felt.

No professional assistant, and only one lay assistant with no experience, was available, but hysterotomy was decided on. The anaesthetic of choice required some thought. I felt the rabbit was not a good subject for ether, and as the litter were valuable, barbiturates in an anaesthetic dose were dismissed. The following procedure was adopted: 25 mg. chlorpromazine hydrochloride was injected intramuscularly, and 45 mg. pentobarbitone sodium injected intraperitoneally. Twenty-five minutes later the doe was sufficiently quiet to allow easy handling. She was secured on her back, the usual surgical procedures adopted, and 3 c.c. of 3 per cent. procaine were injected along the mid-line.

An incision about 3 inches long was made and the operation carried out in the normal manner. Eight living young and one small dead one were delivered. When suturing had been completed the prolapse was reduced with a blunt probe and did not appear thereafter.

300,000 units penicillin were given subcutaneously and the doe was moving around normally 10 minutes after the last suture was tied. Subsequent history was uneventful and the animal behaved as if nothing untoward had occurred.

The doe refused to accept the litter and an attempt to rear them on glucose and milk was made. They all died between the fourth and eighth day. If some substitute such as "Sowlac" had been given, more success might have been gained.

Colleagues have expressed the opinion that the prolapse was vaginal mucosa and this is likely. An attempt to find bladder intra-abdominally or in the pelvic cavity failed, but no lengthy search was made in order to reduce handling of viscera to a minimum.

Yours faithfully,
J. W. MACKAY.

5, College Avenue,
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October 12th, 1959.

DISEASES OF ANIMALS ACT, 1950—GREAT BRITAIN
Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period		Anthrax	Atrophic Rhinitis	Foot-and-Mouth	Fowl Pest	Sheep Scab	Swine Fever
16th to 31st August, 1959		8	—	—	11	—	47
Corresponding period in	1958	2	1	1	51	—	33
	1957	4	—	1	15	—	36
	1956	11	—	31	29	—	28
1st Jan. to 31st Aug., 1959		148	—	9	477	—	779
Corresponding period in	1958	106	4	114	477	—	898
	1957	252	6	39	551	—	652
	1956	1,085	8	80	457	—	529